Service and Repair Manual

applies to Sinus 503, Sinus 582 and Sinus 912 equipped with Rotax 503, Rotax 582 and Rotax 912 engines (all TW and NW versions)

and

Virus 912 equipped with Rotax 912 engine (all TW in NW versions)

Revision 1
updated 18th June, 2012

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Index of revisions

Enter and sign the list of revised pages in the manual into the spaces provided below. All revised pages should be clearly designated in the upper right corner of the page, also, any changes in page content should be clearly visible (e.g. marked with a bold vertical line)

Name of revision	Revision no. date	Signature, date	Description
Revision 1	1, 18th June 2012	Tomazic, Coates 18th June 2012	Checked all spelling in document US English

List of valid pages

This manual contains 74 original and revised pages listed below.

	Pages	State
Cover	1	**Original**
Index of revised pages	2	**Original**
List of valid pages	3	**Original**
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General	7 - 9	**Original**
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Caution:

This manual is valid only if it contains all of the original and revised pages listed above.

Each page to be revised must be removed, shredded and later replaced with the new, revised page in the exact same place in the manual.

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General

Introduction

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Introduction

This manual contains all information needed for appropriate and safe servicing of Sinus ultralight motorglider models 503, 582, 912 and Virus 912.

In case of aircraft damage or people injury resulting form disobeying instructions in the manual PIPISTREL d.o.o. denies any responsibility.

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IT IS MANDATORY TO CAREFULLY STUDY THIS MANUAL PRIOR TO USE OF AIRCRAFT

Notes and remarks

Safety definitions used in the manual:

WARNING! DISREGARDING THE FOLLOWING INSTRUCTIONS LEADS TO SEVERE DETERIORATION OF FLIGHT SAFETY AND HAZARDOUS SITUATIONS, INCLUDING SUCH RESULTING IN INJURY AND LOSS OF LIFE.

CAUTION! DISREGARDING THE FOLLOWING INSTRUCTIONS LEADS TO SERIOUS DETERIORATION OF FLIGHT SAFETY.

Materials used in manufacturing process

Composite parts are made of:

fabric:	GG160, GG200, 90070, 92110, 92120, 91125, 92140, 92145, KHW200
roving:	NF24
foam:	75 kg/m3 PVC 3mm, PVC 5 mm, PVC 8mm
GFK:	3 mm, 5 mm, 7 mm of thickness
paint:	gelcoat
heat resistant protection	glass-aluminium sandwich

Metal parts used are:

tubes:	materials: Fe0146, Fe 0147, Fe0545, Fe1430, AC 100, CR41 in LN9369
sheet metal:	materials: Fe0147 in Al 3571
rods:	materials: Fe 1221, Fe 4732, Č4130, Al 6082, CR41 in Al 6362
cable:	AISI 316
bolts and nuts:	8/8 steel

All composite parts are made of glass, carbon and kevlar fiber manufactured by Interglas GmbH.

All parts have been tested at safety factor 1.8, meaning stressed to 7,2 G

All parts are made in moulds, therefore no shape or structural differences can occur.

All designing, manufacturing and testing complies with following regulations:
- **Bauvorschriften für Ultraleichtflugzeuge des Deutschen Aero Club e.V. Beauftragter des Bundes-ministeriums für Verkehr**
- **JAR-1 microlight definition**
- **EASA CS-22 - certain sections**
- **EASA CS-VLA -certain sections**

for Slovenian market also: **Pravilnik o ultralahkih napravah Republike Slovenije.**

All parts and materials presented in all versions of Sinus ultralight motorglider and Virus 912 are also being used in glider and general aviation industry and all comply with aviation standards.

WARNING! **WHEN SERVICING OR REPLACING PARTS ALWAYS USE THE SAME MATERIAL AS USED ORIGINALLY (SEE ABOVE).**

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Servicing the aircraft

Introduction

Repairs and
spare part replacements

Inspection periods

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repair

Example of wing FRP
repair

Weight and Balance

Introduction

This chapter determines handling and (preventative) maintenance terms. Also, recommended ground handling is presented.

Repairs, spare part replacements and preventative maintenance

All major repairs and spare part replacements MUST be done by authorised service personnel.

However, you are encouraged to take care of preventative maintenance yourself. This includes: **tire and wheel bearings replacements, safety wire replacements, door and safety harness replacement, light bulb replacements, fuel hose replacements, battery servicing and replacement, sparks and spark plugs replacements and air filter replacements.**

The table below indicates recommended maintenance periods (see Service manual for detailed information).

Table legend:

- **C** **Check-up** - visual only, check for free play and whether everything is in position - **DO IT YOURSELF**
- **CL** **Cleaning - DO IT YOURSELF**
- **LO** **Lubricating, oiling** - lubricate all designated parts and spots using proper lubricant - **DO IT YOURSELF**
- **R** **Replacement -** replace designated parts regardless of state and condition. You are encouraged to **DO** undemanding replacements **YOURSELF**, otherwise have replacements done by **AUTHORISED SERVICE PERSONNEL**
- **SC** **Special check-up** - measuring, verifying tolerances and functionality - **DONE BY AUTHORISED SERVICE PERSONNEL ONLY**
- **O** **Overhaul**

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
WING AND TAIL SURFACES							SC	O
surface and structure condition	C				SC			
deflections without free play	C			SC				
bearings - moving parts' bushings	C					SC		
lights	C							
self-adhesive sealing tape	C	C			SC			
horizontal tail mount	C	C		SC				
drain holes	CL							

	daily	fist 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
FUSELAGE							SC	O
surface and structure condition	C						SC	
elevator control tube bearing				C		SC		
undercarriage struts attaching points		C	C	SC				
doors, hinges	C	C		SC	LO			
rudder control wires and hinges		C	C			SC		
CABIN							SC	O
control levers, instr. panel, seats	C			SC				
control levers' free play	C	C		SC				
instruments and pitot-static	C			check yearly				
glass surfaces: clean, attached	C	C			SC			
rivet condition	C					SC		
safety harnesses and attach. points	C			SC				
parachute rescue sys. activation handle	C					SC		
wing connectors: fuel, electrical	C	C		SC				
bolts and spar pins	C	C		SC				
wing main bushings, control connectors				SC				
UNDERCARRIAGE								O
tires	C		replace on condition or every 5 years					
main strut, tail /nose wh. strut condition	C	C		SC				
wheel axis and wheels				C				
hyd. brake lines	C			SC			R	
brake fluid	C				SC	R (500 hrs or 5 years)		
brake discs					SC	(R on condition)		
wheel bearings			C		SC	R		
tail wheel main bolt			C			R		
wheel fairings	C	C	C					
tail wheel mounting bolt	C			SC				
CONTROLS (LO every 200 hrs or yearly)								R
general free play	C	C		SC				
control stick	C			LO		SC		
rudder pedals (damage, centered, paral.)	C	C		C				
rudder wire rope	C			SC				
bolts, visible bearings (tail, fuselage)				SC				
difficult-to-reach bearings (wings, under cabin floor)						LO+SC		
aileron, elevator and rudder hinges				SC				
equal spoiler extension, undistributed m.	C			SC		LO+SC		
spoiler plate springs stiffness	C		LO					
flap handle	C			SC				
elevator trim			C	R cable every 500 hrs				
springs: flaps, rudder, el. trim, stabilizer main fastening bolt				LO	C	R		
spoilers' (airbrakes') drive fine adjustment				see page 15 for detailed description				

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
ENGINE								
see enclosed Rotax engine manual for detailed engine maintenance information.								
In addition to Rotax manual:								
two-stroke engines (overhaul every 300 hours)			C					
four-stroke engines (overhaul every 1,500 hours)			from engine serial number 4404718					
engine cover screws	C	C		C				
engine mount	C	C		SC				
engine mount dumpers and other rubber parts		C		SC		R every 500 hrs or every 5 years		
air filters	C	C		CL		SC		
elect. terminals, joints and connectors, hoses, radiator mount	C	C		SC				
exhaust muffler	C	C		SC		SC		
exhaust pipe springs and fire protect.	C	C		SC		R		
throttle, choke, propeller wire drive				SC		R		
ENGINE CONTROL								O
choke and throttle lever wire ropes	C	C		SC		R		
levers	C			SC				
PROPELLER AND SPINNER					SC	O		
surface condition	C							
fastening bolts					R			
propeller bushings					R			
propeller pitch	C				SC			
propeller balance	C				SC			
FUEL SYSTEM						O every 1000 hrs or 5 years		
general leakage	C	C		SC				
water inside gascolator	C							
dirt and gascolator filter		CL	CL	CL		R		
wing fuel tank caps	C							
fuel tank caps o-ring				R every 500 hrs or 5 years				
fuel valves and leakage	C							
ELECTRICAL WIRING							SC	R
battery	C	C		SC				
battery fluids		C	C	SC				
instr.panel wires and connectors		C		C				
NAV, AC and LDG lights	C	C						
fuses		C		C				

	daily	first 5 hours	50 hours	100 hours	200 hours	500 hours	1.000 hours	10.000 hours
OIL AND WATER LINES						**O every 500 hrs or 5 years**		
oil and cooling fluids level	C	C						
oil and cooling fluids leakage	C	C						
four stroke engine oil (and engine filter) first 25 hours +				refer to engine manual				
cooling fluid (level)				refer to engine manual				
hoses	C	C				R		
radiators	C	C						
water radiator pressure cap				refer to engine manual				

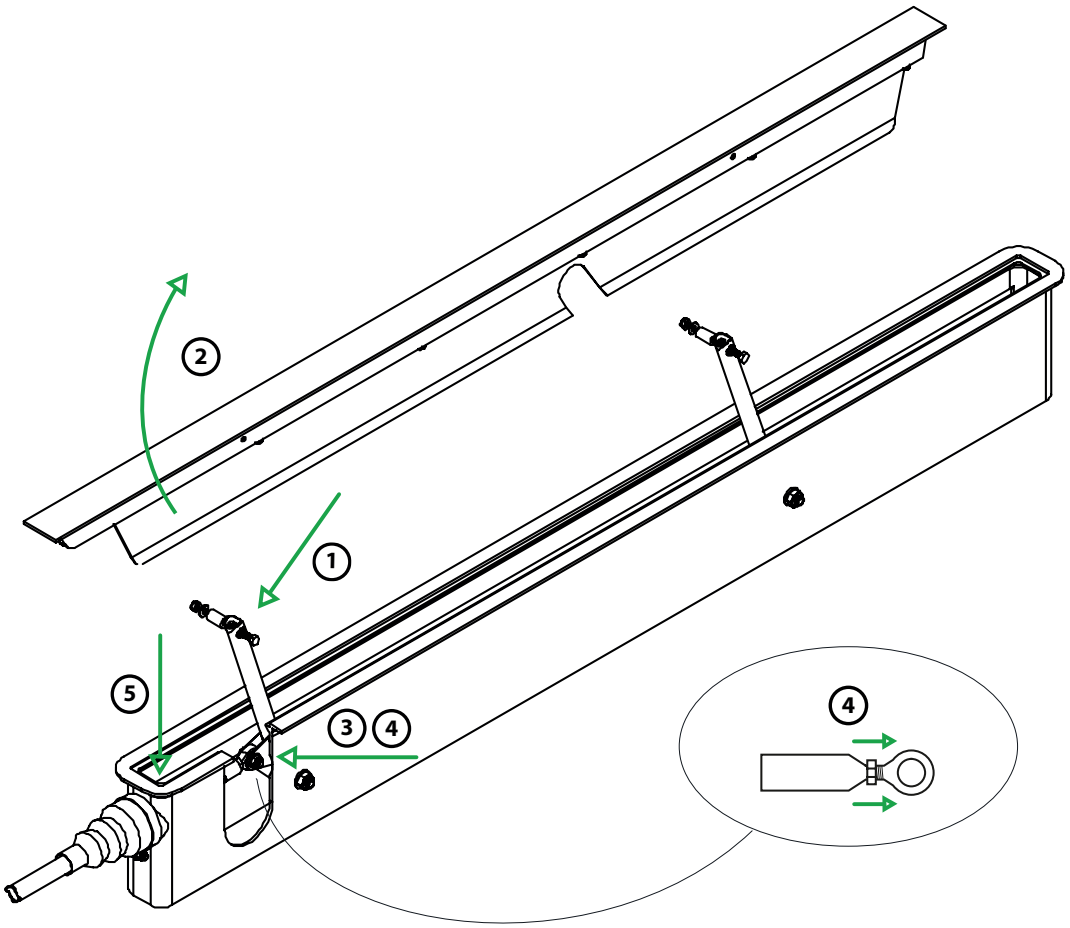
							SC	O
PITOT-STATIC LINING								
instrument to pitot tube lining		C		C				
instrument setting	C	C						
pitot tube condition (clean, firmly att.)	C	C						
whole pitot-static lining		C		C				

Spoilers' (airbrakes') drive fine adjustment

CAUTION! Perform this operation only once after first 50 flight hours! Check spoilers thoroughly for unobstructed, smooth and even extension every 200 flight hours!

Schematic of spoilers' (airbrakes') drive fine adjustment

(see next page for detailed description)



Perform the adjustment as follows:

1. **Unscrew and remove the inner horizontal bolt of the airbrake's plate. Do not lose any parts!**
2. **Lift the airbrake in order to make room for further operation.**
3. **Unscrew and remove the bolt attaching the rod-end bearing to the airbrake's plate lever. Do not lose any parts!**
4. **Rotate the rod-end bearing fine-setting nut 360° so that the rod end moves towards the other end of the airbrake's box (length of rod increases). Make sure you secure this nut after turning it for 360°!**
5. **Grease the drive around the rubber sleeve inside the airbrake's box using rubber-non-agressive lubricant spray.**

Once you have accomplished this, repeat steps 1-3 in opposite order (3,2,1). Make sure you apply adhesive (e.g. Loctite) on all screws when reattaching!

Perform the procedure at the other airbrake as well. In the end verify airbrakes for equal extension.

WARNING! Should the airbrakes not retract evenly, apply step action 4 again for the airbrake, which remains higher when retracting.

Vital stages of spoilers' (airbrakes') drive fine adjustment in pictures

Spoiler's (Airbrake's) plate

1

Horizontal bolt of the AB's plate

1

Rod-end bearing

3

4

Clicking noise overhead

The wings are factory fitted to the fuselage to make a tight fit at approximately 20° Celsius. When exposed to low temperatures, materials shrink. Therefore, flying in the winter or in cold temperatures, you may encounter "click-clack" like noises above your head. The remedy for this unpleasant noises is to add washers, typically of 0,5 mm thickness in-between wing and fuselage. Washers must be added both at rear and front bushings at one side of the fuselage only!

WARNING! It is mandatory to consult the manufacturer or authorised service personnel before applying washers!

Adjustment of tail wheel steering clutch stiffness

To adjust the stiffness of tail wheel steering clutch you need two allen keys (a.k.a. hex-wrench, inbus-key). On top of the wheel fork you will notice a ring with two tubes welded to each side with hex-bolts inside. First disconnect the springs at the tubes, then stick an allen key into each of these tubes and tighten or loosen the screw inside. Make sure, tightening or loosing, you apply equal number of screw rotations at both sides. To check if the steering clutch is stiff enough, lift the tail and rotate the fork left and right. At the end, reattach both springs to the tubes again.
(see Service manual for photos)

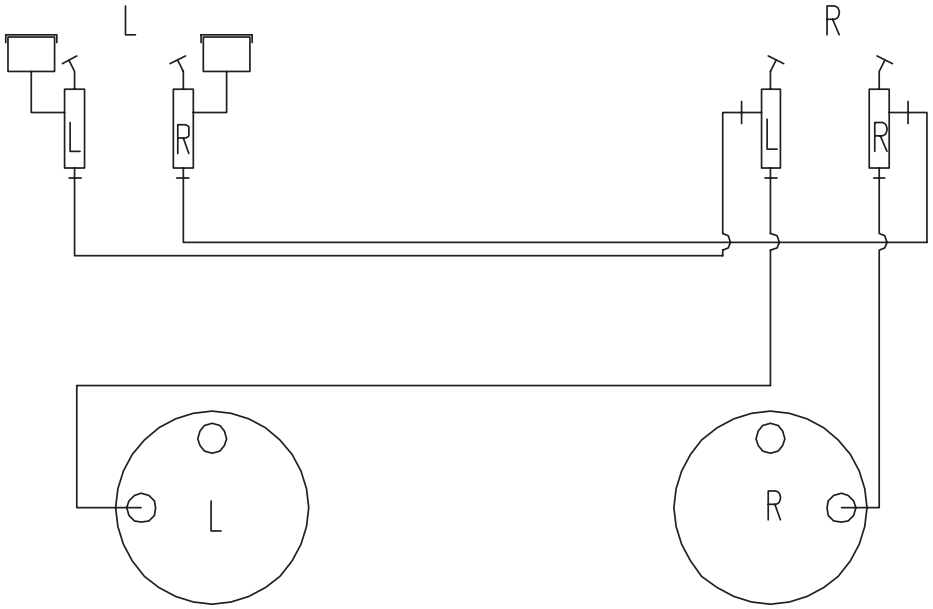
Venting the hydraulic brakes' lining

In case you notice poor braking action even when hydraulic brake levers are depressed fully, it is most definitely necessary to vent the hydraulic lining. To do so, first unscrew the caps of small fluid reservoirs (behind rudder pedals on one side of the cockpit) and remove the inner seal cap.

At the side where there are no fluid reservoirs grab the whole rudder pedal and deflect it back fully, so that it becomes level with the cockpit's floor beneath. Now, at the side where there are fluid reservoirs, jerk brake levers back and forth a couple of times - this will push air bubbles towards the reservoir and out of the lining. When convinced air bubbles are no more, put seal caps back onto the reservoirs and screw the caps on as well. Repeat the procedure for the other brake lever.

WARNING! Should you encounter any difficulties during this procedure or the air bubbles would not vent, please consult the manufacturer or authorised service personnel for further instructions.

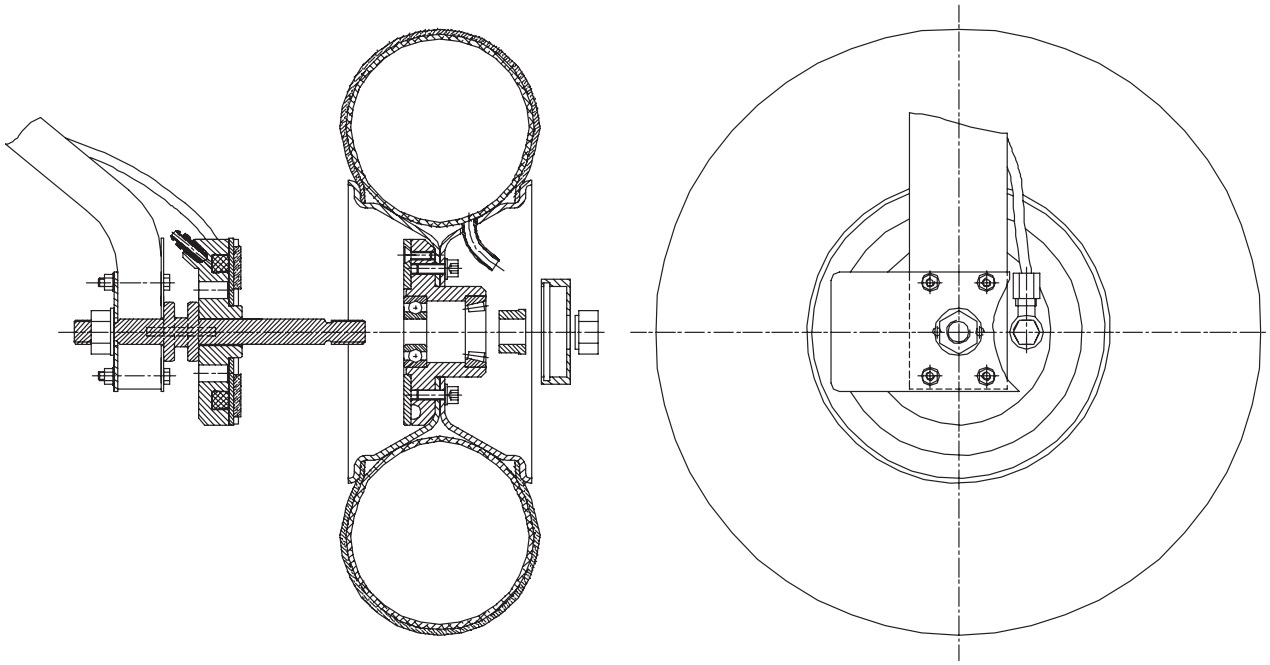
Schematic of hydraulic brakes' lining



Poor braking action

In case you notice poor braking action even when hydraulic brake levers are depressed fully, it is not necessary the air bubbles in the hydraulic lining, which is causing the problem.
The main wheel's main axis' nut (especially after a wheel and/or axis replacement nut) may be tightened incorrectly so that the brake shims do not make contact with the brake plate. Please consult the manufacturer or authorised service personnel for further information.

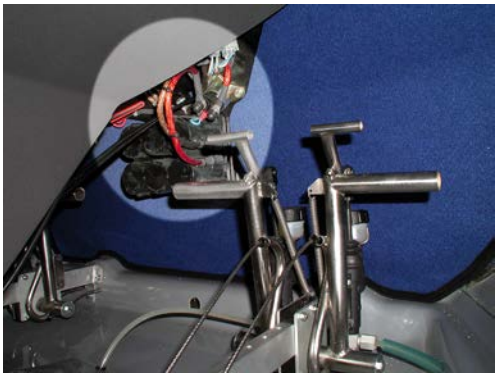
Schematic of wheel and wheel brakes



Connecting Auxiliary power supplies

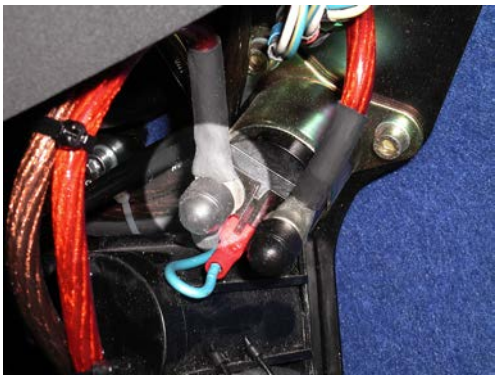
Should you be unable to start the engine due to a weak battery, auxiliary power supplies can be connected to help starting the engine.

Battery's & Relay's location



Battery (black) & Relay (top-right)

Top-left nipple (c. positive (+) wire here)



Exhaust (connect negative (-) wire here)

To connect an auxiliary power supply use battery connector cables with clamps at either ends.
Connect the negative (-) wire to aircraft's exhaust (sticking out below the engine cowlings).
The positive (+) wire leads inside the cockpit to the relay mounted top-right of the aircraft's battery on the firewall. This relay has 3 nipples; the positive (+) wire must be connected to the upper-left nipple, the only one to which 2 cables are connected to.
After you have connected the wires correctly, start the engine normally by pressing the starter button in the cockpit.

WARNING! The pilot must be in cockpit when starting the engine. The person who will disconnect the cables after the engine has started must be aware of the danger of spinning propeller nearby.

Fibre reinforced plastic repairs

WARNING! Do not, under any circumstances attempt to repair damages greater than 50 mm in size (on wing) and/or 20 mm in size on any control circumstances. These require a treatment by a FRP professional!

Definition of minor damage

Only the damage listed below can be considered as minor damage repairable by oneself.

Any damage limited to gelcoat or filler.
Holes in the fuselage underside where the average diameter does not exceed:

Forward fuselage: 50 mm
Rear fuselage: 50 mm

Cracks in fuselage underside max.

Forward fuselage: 50 mm
Rear fuselage: 50 mm

The fuselage glued joint (rear fuselage) should not be damaged.

Holes, cracks and tears, bubbles etc. in the wings, horizontal stabilizer and control surfaces skins where the damage does not exceed (average diameter crack length):

Wings: 50 mm (50 mm)
Horizontal stabilizer: 20 mm (20 mm)
Rudder: 20 mm (20 mm)
Flaperon, Elevator: 20 mm (20 mm)

The above parts should not be damaged in the spar area.
Damaged fittings should not be repaired but replaced.

Facilities

To insure proper curing, the room temperature during repair work and at least 12 hours afterwards should be maintained at 21°C (70° F). After that the repaired parts are to be tempered. Therefore you may construct a tempering tent, using plastic film or Styrofoam plates.

Filler

For gluing, the resin-hardener mix should be thickened with chopped cotton fibres FL l f. (add enough so that the resin no longer flows). The surfaces to be glued should be wetted with non-thickened resin & hardener before.
To glue foam pieces into place when repairing sandwich sections and to fill in irregularities and gaps etc. around the repair, Microballoons BJO - 0930 can be used mixed with the resin-hardener. Application and mixing is the same as for the cotton flocks.

WARNING! Only materials listed on page 9 should be used. Only damage defined above should be repaired.

Repair method for FRP

Cut out damaged area, roughen the surrounding area for the overlap required. Repairs should be made such that bonding is **wet over dry**. Specific details concerning handling and using fibre reinforced plastics can be obtained from various publications ie. "Petite Plane Patch Primer."
The use of Carbon fibre is the same as for glassfibre, except that the carbon fibres should not be kinked and only the specified resins are used.

WARNING! All repairs should be tempered for 20 hours at 54°C before the next take off.

Repairs of the FRP shell

Prepare the repair area as specified above. Scarf the shell so that the individual layers of fabric can be seen like plywood layers. Remove the gelcoat for at least 20 mm around the damaged area.

Repairing the outer skin of a sandwich panel

Cut out the damaged area, remove the gelcoat over the overlap area and 10 mm around the damaged area. Fill the damaged foam area with resin thickened with microballoons (microballoons-resin), let harden. Sand down. With a round headed hammer tap the outer skin around the hole so that the foam is somewhat compressed, therefore heat this area to ca. 60°C (140°F). Apply the new cloth.

Repair of outer and inner skin of a sandwich panel

Additionally remove as much foam as is needed so that the entire damage to the inner skin can be seen plus enough undamaged inner skin as is required for overlapping. If the inner skin still holds together, sand properly and lay up the new cloth over it. Insert a suitable cut piece of foam, 1-2 mm thinner than the original, glued in with microballoons-resin. Should the inner skin be so damaged that the above process cannot be use the inner skin fabric should be applied to the foam first and left to harden before inserting into the repair area. Microballoons-resin should once again be used. For lay up of the fabric to the foam, a layer of microballoons-resin should be applied first to eliminate the formation of air bubbles. Apply outer layers

Special hints for processing aramid fibres

The difficulties processing aramid fibre starts already when cutting the fabric. Only with very sharp tools (toothed scissors) cutting the material is possible. Sanding the fibres is not possible without formation of fluff or fuzz. Only wet sanding is feasible. After sanding, the area must be dried with a fan heater.
Aramid fibre has the tendency to take up humidity. Therefore dry storage and drying the fibres prior to processing is necessary. Aramid must be protected against UV-rays before and after processing. An aramid repaired area must be protected by a paint with UV-protection. Thin aramid layers can't be scarfed. Only overlapping is possible.

Repair of the carbon fibre - aramid fibre – hybrid fuselage shell

With this construction the repair method see mentioned above is not applicable. Contact the manufacturer.

Repairing small dents in a sandwich panel skin (no cracks in the gelcoat)

Small dents can usually be removed by heating up to 60° to 70° C (140° -158°F). Use a hot air blower to heat the area of the dent. The crushed foam will then spring back to its original form, so that the dent will hardly be seen. Final sanding with wet sandpaper grade 600 should finish the job. In more severe cases, one coat of gelcoat will remove all trace of the dent.

Outer skin finish

Repairs should be such that the area is exactly level or only slightly higher than the surrounding skin surfaces. Sand the hardened repair surface with dry grade 80 sandpaper. Fill with Polyester filler, let dry and sand with dry sandpaper. When the surface is smooth, sand the repair area and at least 5 cm (2 in.) of the surrounding gelcoat with wet sandpaper grade 400. Spray the repair area with 5 coats of gelcoat.
After the gelcoat has hardened, sand with grade 400, 600 and 800 wet sandpaper until the surface is smooth. Polish with a power buffer (electric drill or similar with cloth polishing wheel). Apply a block of wax onto the rotating polishing wheel and then polish the repaired area. Do not polish in only one direction, and do not polish one spot for too long to prevent material overheating.

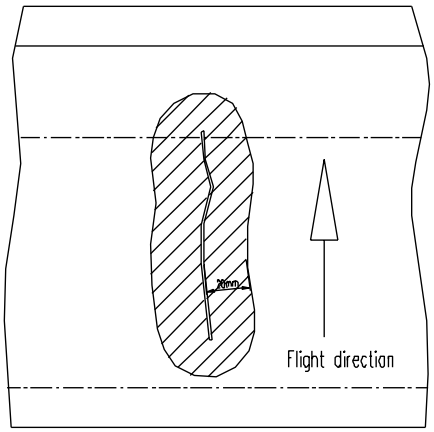
WARNING! After repairing control surfaces, the mass balance weights MUST be checked again with the values given in the maintenance manual. Should the maximum values be exceeded, then the parts have to be replaced.

Example of flaperon FRP repair

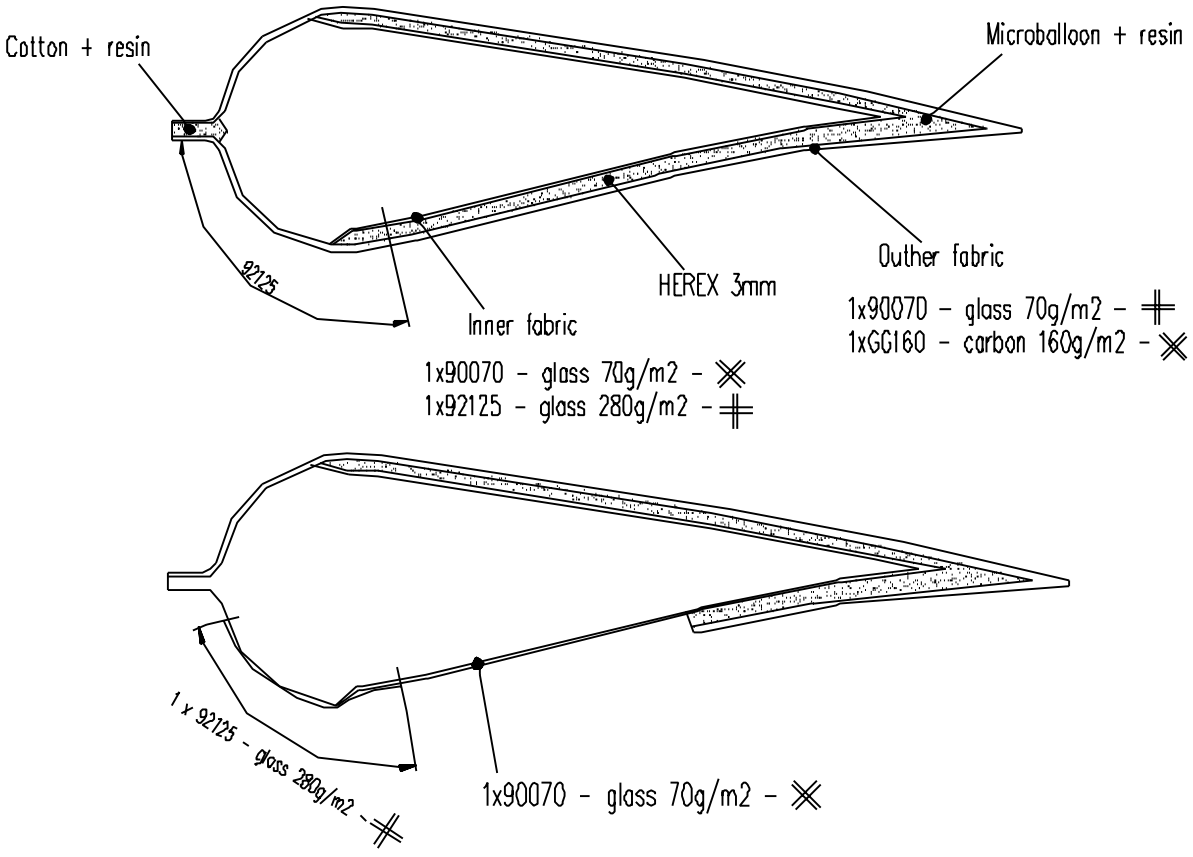
WARNING! Do not, under any circumstances attempt to repair damages greater than 50 mm in size (on wing) and/or 20 mm in size on any control circumstances. These require a treatment by a FRP professional!

Phase I

Carefully cut and remove the damaged foam (Herex 3 mm) in width of at least 20 mm around the damaged area.
Clean the area, paying special attention that the inner fabric is immaculate. This is of vital importance. After you have cleaned and rinsed everything, laminate the 20 mm area according to the laminate-plan shown on the drawing below.



Laminate plan for flaperon

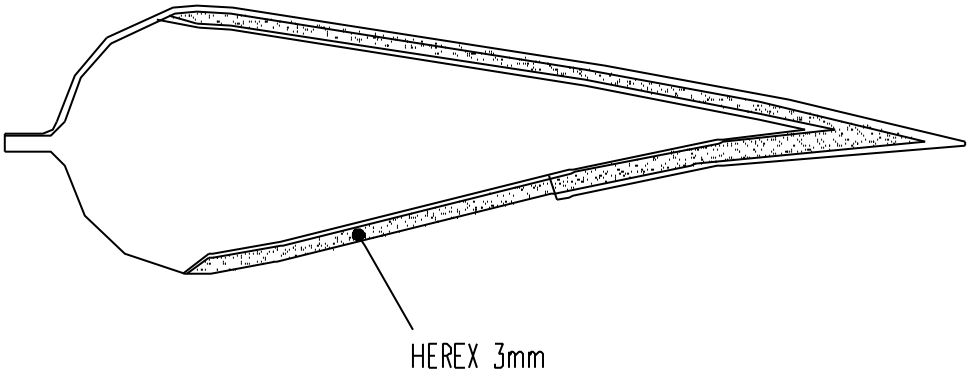


WARNING! if the damage area is located on the flap hinge (the fabric used there is carbon fibre - black color) you must laminate using one ply of GG160 fabric, oriented diagonally to the flight direction. Also, you must apply Peel Ply on top of GG160.

Phase II

Remove the Peel Ply and adapt a new piece of foam (Herex 3 mm) as accurately as you possibly can and glue it with microballoons.

WARNING! Do not apply too much pressure anywhere!

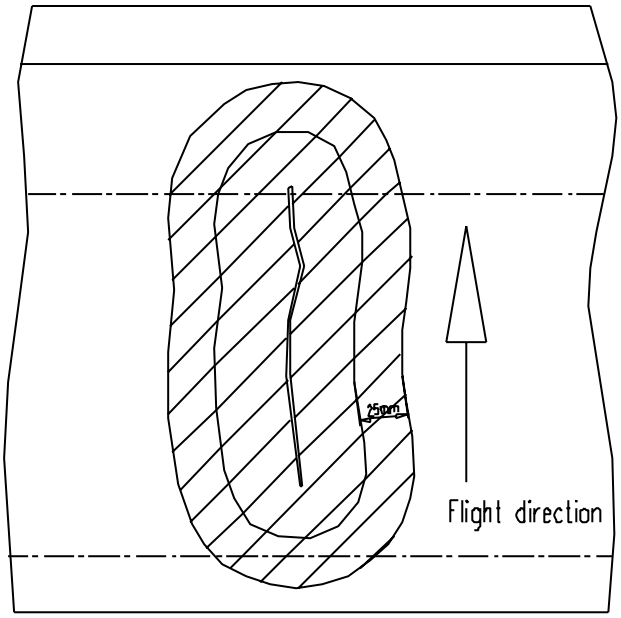


Phase III

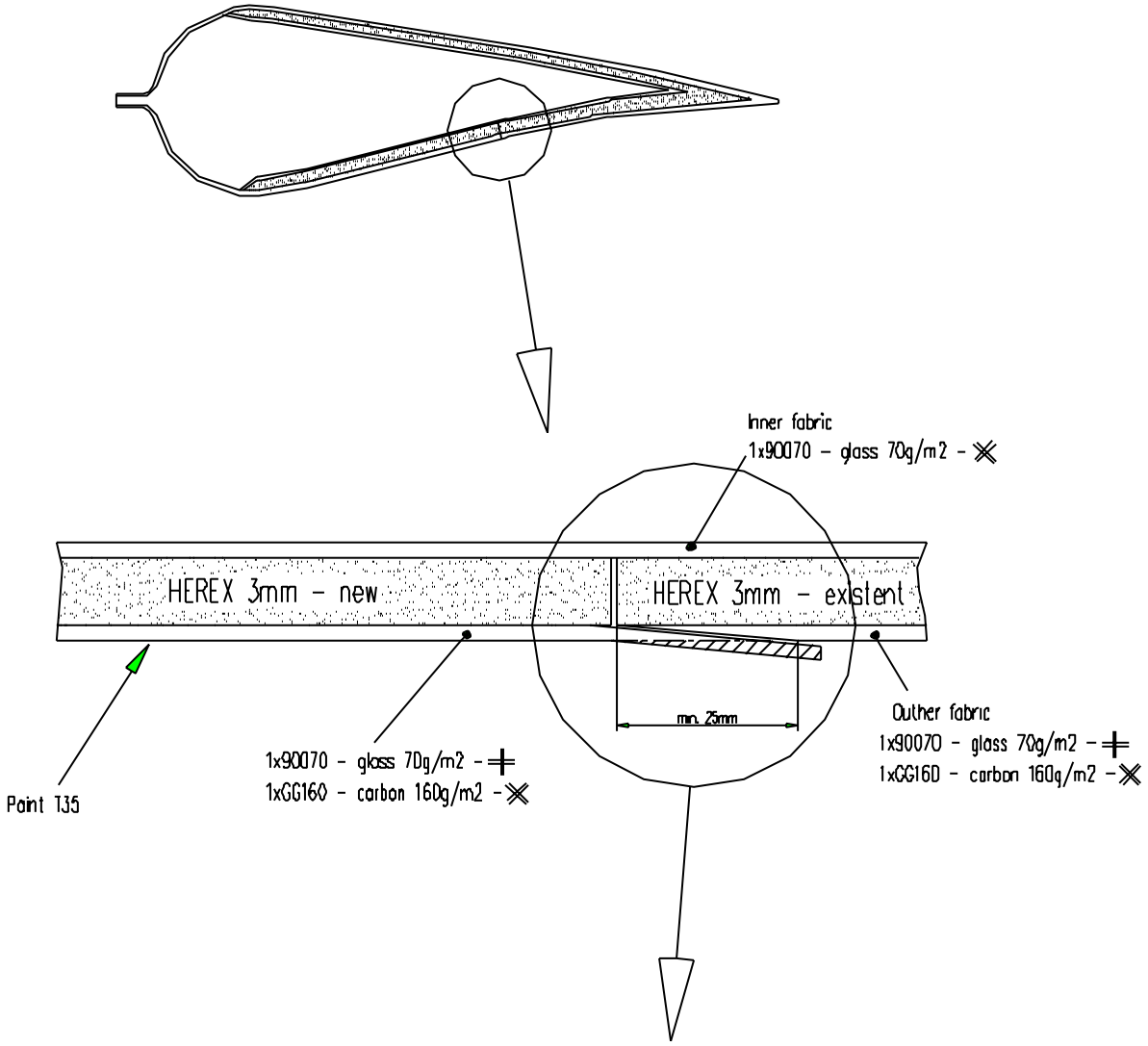
Grind the foam if its level is too high. Also grind the external laminate around the cut-out for about 25 mm in a conical-shape (see next drawing). When done, laminate as follows:
- Place one (1) piece of GG160 diagonally and
- One (1) piece of 90070 perpendicular to the flight direction.

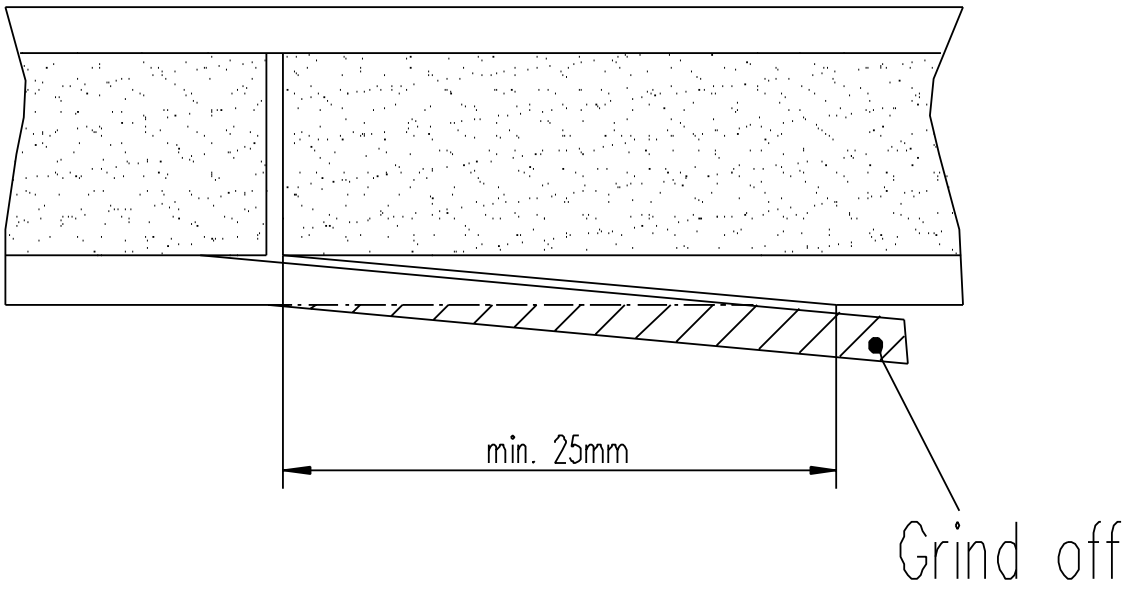
Phase IV

Grind only the outer edge of the new fabric. When done, the new surface is ready to be painted.



Drawing of skin final repair



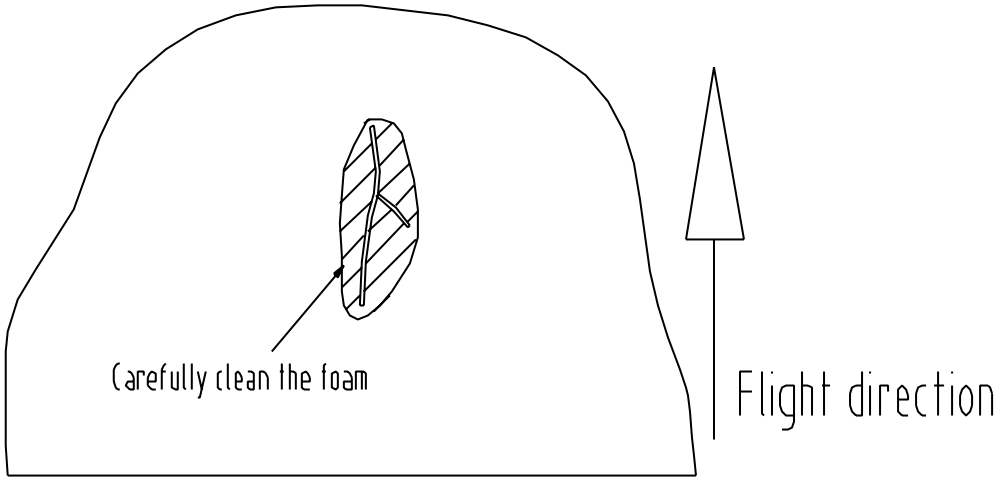


Example of wing FRP repair

WARNING! Do not, under any circumstances attempt to repair damages greater than 50 mm in size (on wing) and/or 20 mm in size on any control circumstances. These require a treatment by a FRP professional!

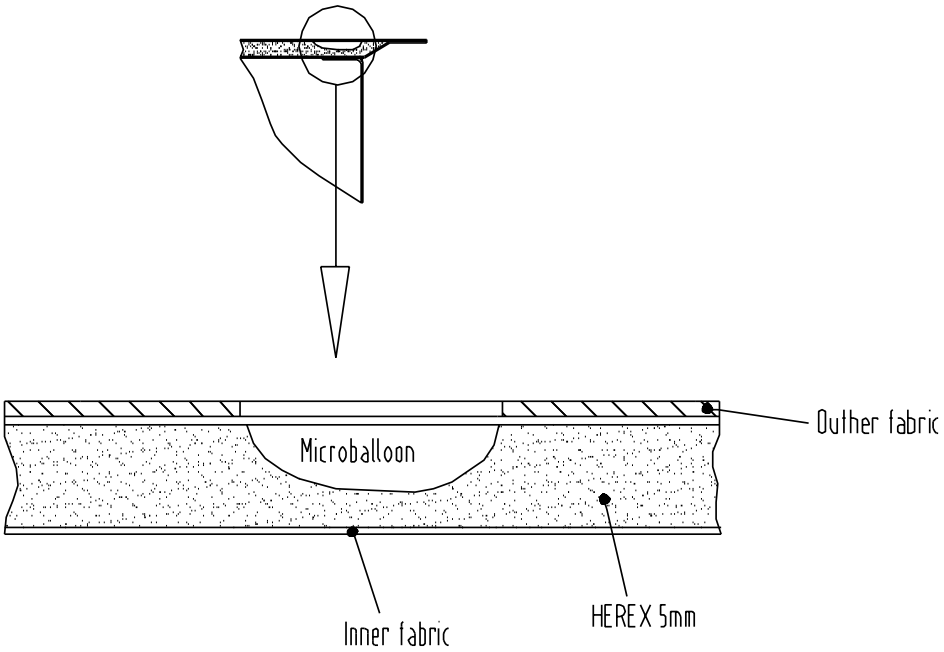
Phase I

Preparing the surface. Carefully clean the damaged foam and check if there is also a damage on the inner fabric.



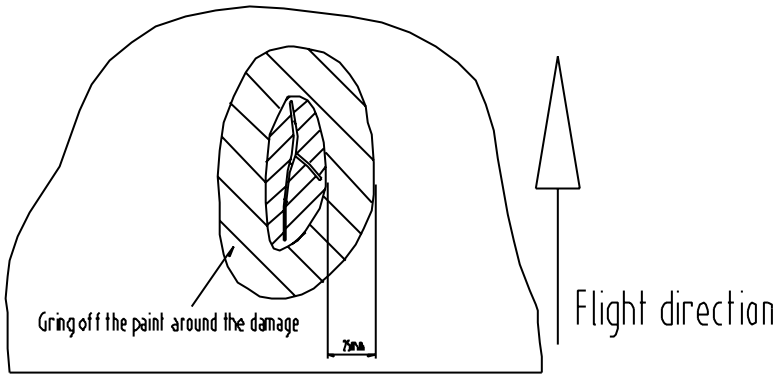
If the inner fabric in not damaged fill the hole with microballoons as you can see on the drawing below. In case the hole is through the inner fabric as well, you have to repair the inner fabric, too.
The new patch must be at least 20mm bigger than the damaged area. You also have to replace (glue) the missing foam with a new one.

Gap filling drawing

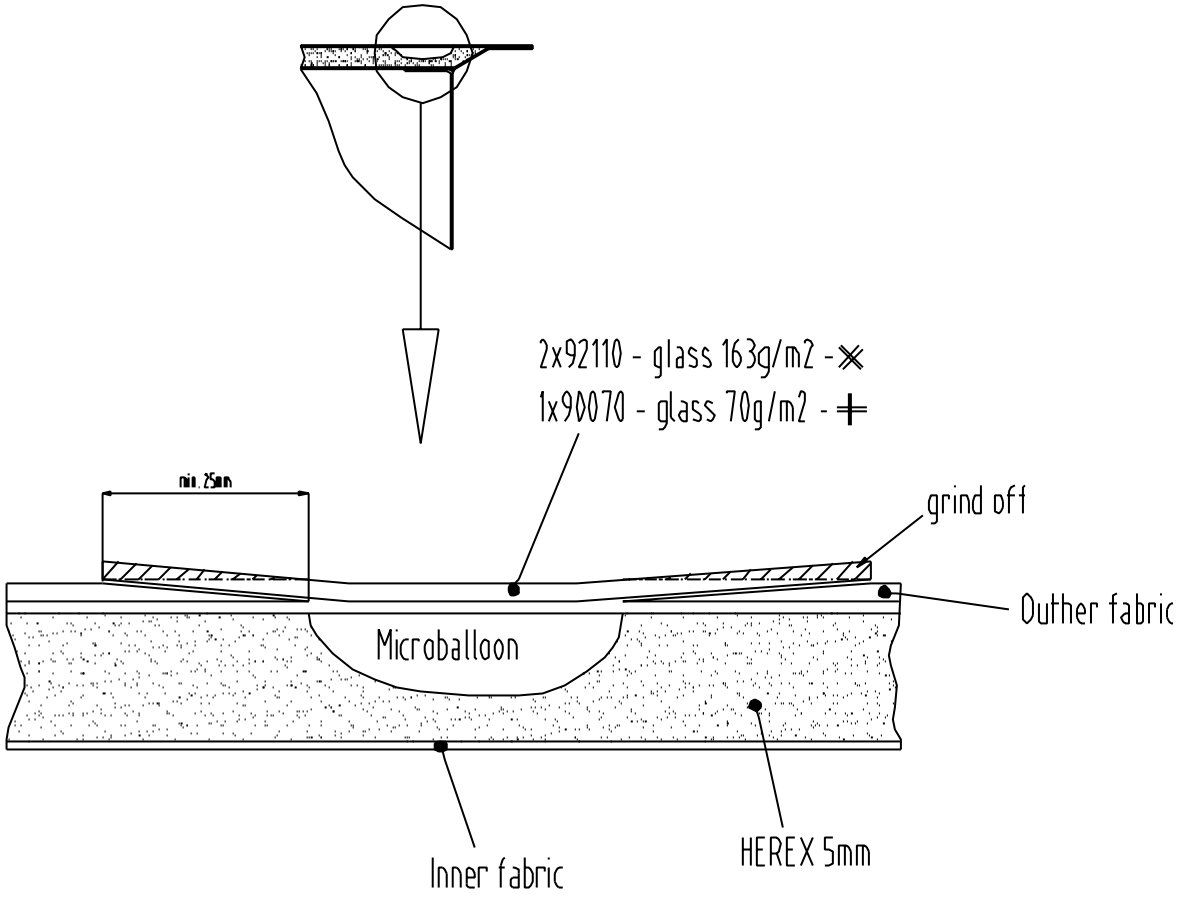


Phase II

Laminating. Grind the outer fabric in a shape of a cone at least 25mm around the damaged area (see drawing below) and laminate only the ground surface with fabrics as follows:
- Two (2) pieces of 92110 and
- One (1) piece of 90070



When laminating be careful about the orientation of the fibres. The fibres of 92110 must be put diagonally to the flight direction, the fibres of 90070 must be put perpendicular to this direction. The directions are also shown in the drawing below.



Phase III

Grinding. You can grind only the surface (ring) around the damaged area. This surface is shawn in previous drawing. When done the surface is ready for painting.

Weight and Balance

This chapter provides information on aircraft's weight and balance, which is essential for safe flying activity.

Procedure

How to weigh the aircraft and later determine the CG correctly:

Make sure all listed aircraft parts and appliances are installed and in position.
Remove all other objects (e.g. tools, mops ...).
Empty fuel tanks except for the unusable fuel.
Fill up engine oil to the top marking.
Retract flaps and spoilers, leave control surfaces centred.
Support fuselage at the rear and level the aircraft inside a closed space.
To do this, use the provided airfoil template at lower side of the wing close to the wing root and make sure its straight edge is level (horizontal).
Once leveled, read the scale readings and subtract eventual tare weight.
Now measure and record all readings and fill out the bottom schematic.
Datum is wing's leading edge at wing root.

CG lever arm formula for Tail-wheel aircraft (Sinus TW, Virus TW, any model):

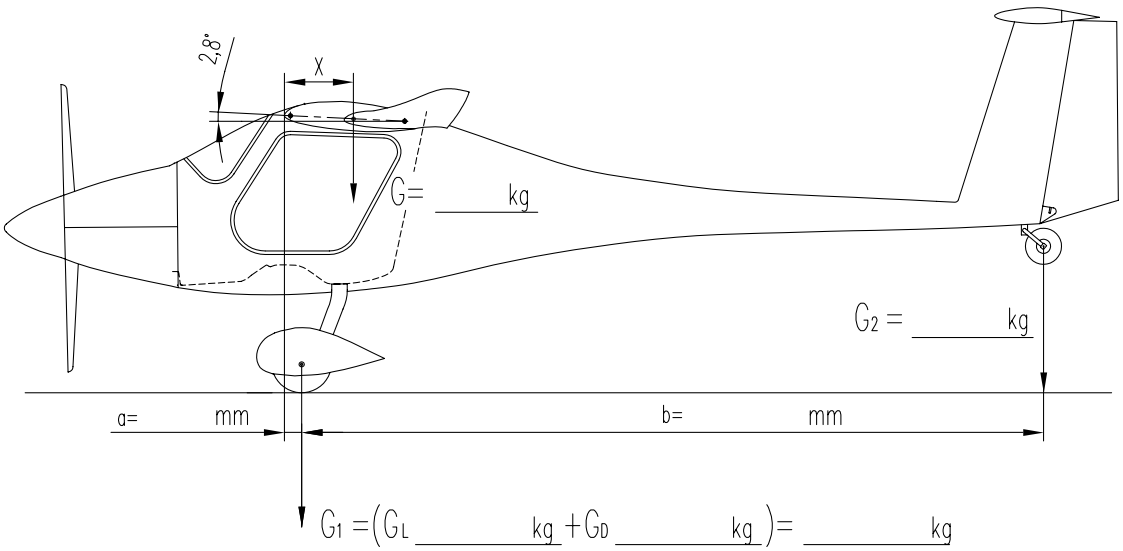
Lever arm of CG (X) = ((G_2 / G) x b) + a

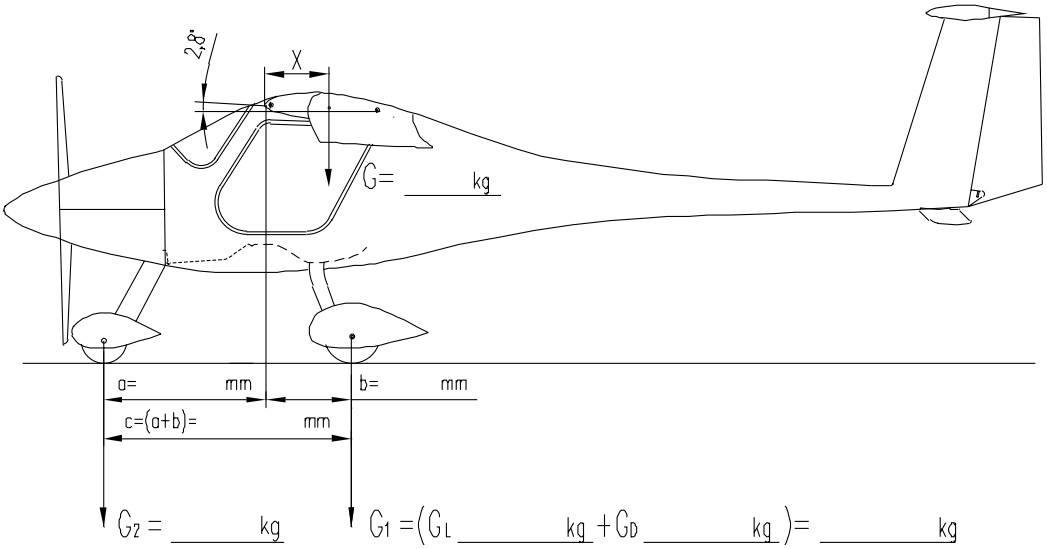
CG lever arm formula for Nose-wheel aircraft (Sinus NW, Virus NW, any model):

Lever arm of CG (X) = ((G_1 / G) x c) - a

Weighing form (TAILWHEEL)

Weighing point and symbol	Scale reading	Tare	Nett
right main wheel (G_D)			
left main wheel (G_L)			
tail wheel (G_2)			
total ($G = G_D + G_L + G_2$)			





Determination of CG

	Weight (kg)	Weight's lever arm (cm)	Torque (kg/cm)	Remarks
Basic cfg. empty weight				

CAUTION! Each newly installed part or appliance must be registered in the upper table. Also, new total weight and lever arm of CG values must be entered and position of CG re-determined. Furthermore, the momentum must be recalculated. This is rather easy to do. First multiply the new part's weight by it's lever arm measured from the reference point (wing's trailing edge). Then sum up all moments and divide the sum by the new total weight.

WARNING! Regard to the Flight manual and Maintenance manual for allowable C.G. limitations!

Sample c.g. calculation

Guidelines

Gtotal is the total mass of empty aircraft. All calculations can be performed with aircraft empty weight and empty weight centre of gravity (c.g.), as the pilots sits directly below the centre of gravity and do not cause the c.g. to be shifted. The amount of fuel quantity also has no impact on the c.g..

WARNING! Both pilots' weight and weight of fuel do not influence c.g. or their influence is insignificant. However, baggage can influence the c.g. severely and may cause the aircraft to become uncontrollable!

Basic CG formulas and calculation

The below instructions are valid for Virus Tail Wheel and Nose Wheel editions. Read thoroughly. Note also that the basic c.g. at 287 mm will be used purely as an example.

First, weigh the aircraft according to the procedure described in this chapter and write down values of G1 (sum of scale readings at main wheels) and G2 (scale reading at tail/front wheel). Then calculate the position of c.g. in millimeters (mm) from the datum (wing's leading edge at wing root).

For Tail wheel edition of Virus use the following formula:

$$CG_{mm} = \frac{G2_{tail} \; x \; b}{G_{total}} + a = \frac{G2_{tail} \; x \; 4300 \; mm}{G_{total}} + 110mm = 287mm$$

where:
G2tail is the scale reading at the tail wheel,
Gtotal is the sum of G1 and G2tail (G1+G2tail), a.k.a. aircraft empty weight
a is the distance from main wheel axis to wing's leading edge,
b is the distance between main and tail wheel axis.

For Nose wheel edition of Virus use the following formula:

$$CG_{mm} = \frac{G1_{back} \; x \; c}{G_{total}} - a = \frac{G1_{back} \; x \; 1525 \; mm}{G_{total}} - 1020mm = 287mm$$

where:
G2back is the sum of scale readings at both main (back) wheels,
Gtotal is the sum of G1 and G2back (G1+G2back), a.k.a. aircraft empty weight
a is the distance from nose wheel axis to wing's leading edge,
b is the distance from main wheel axis to wing's leading edge,
c = (a+b) is the sum of both distances above.

Second, determine the c.g. position in percentage (%) of Mean Aerodynamic Chord (MAC) with following the formula:

$$CG_{\%MAC} = \frac{CG_{mm} - R}{MAC} \; x \; 100 = \frac{287mm - 29mm}{908mm} \; x \; 100 = 28.4\%$$

where:
CGmm is the position of CG in millimeters (mm),
R is the difference between wing's leading edge and MAC's leading edge (29 mm),
MAC is the Mean Aerodynamic Chord (908 mm, for Sinus it is 869 mm).

Schematics

Control levers

Wings

Tail surfaces

Undercarriage

Brakes

Fuel system

Engine cooling system

Engine lubrication system

Throttle and choke drive

Electrical system

Control levers

Flap handle, 1

INSPECTION PERIODS

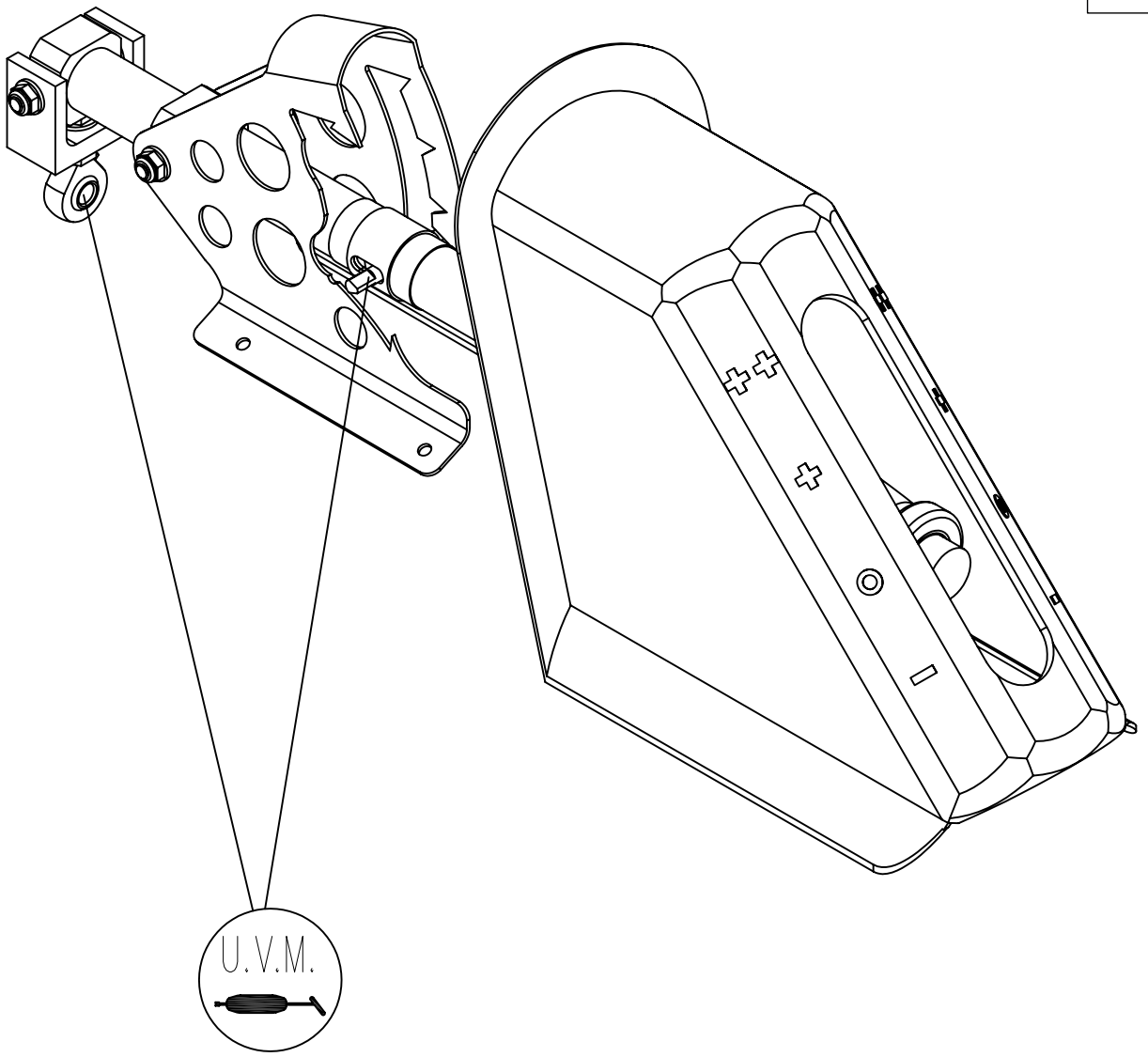
50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

SYMBOLS

glue
grease
oil
hand insp.



Flap handle, 2

INSPECTION PERIODS

50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
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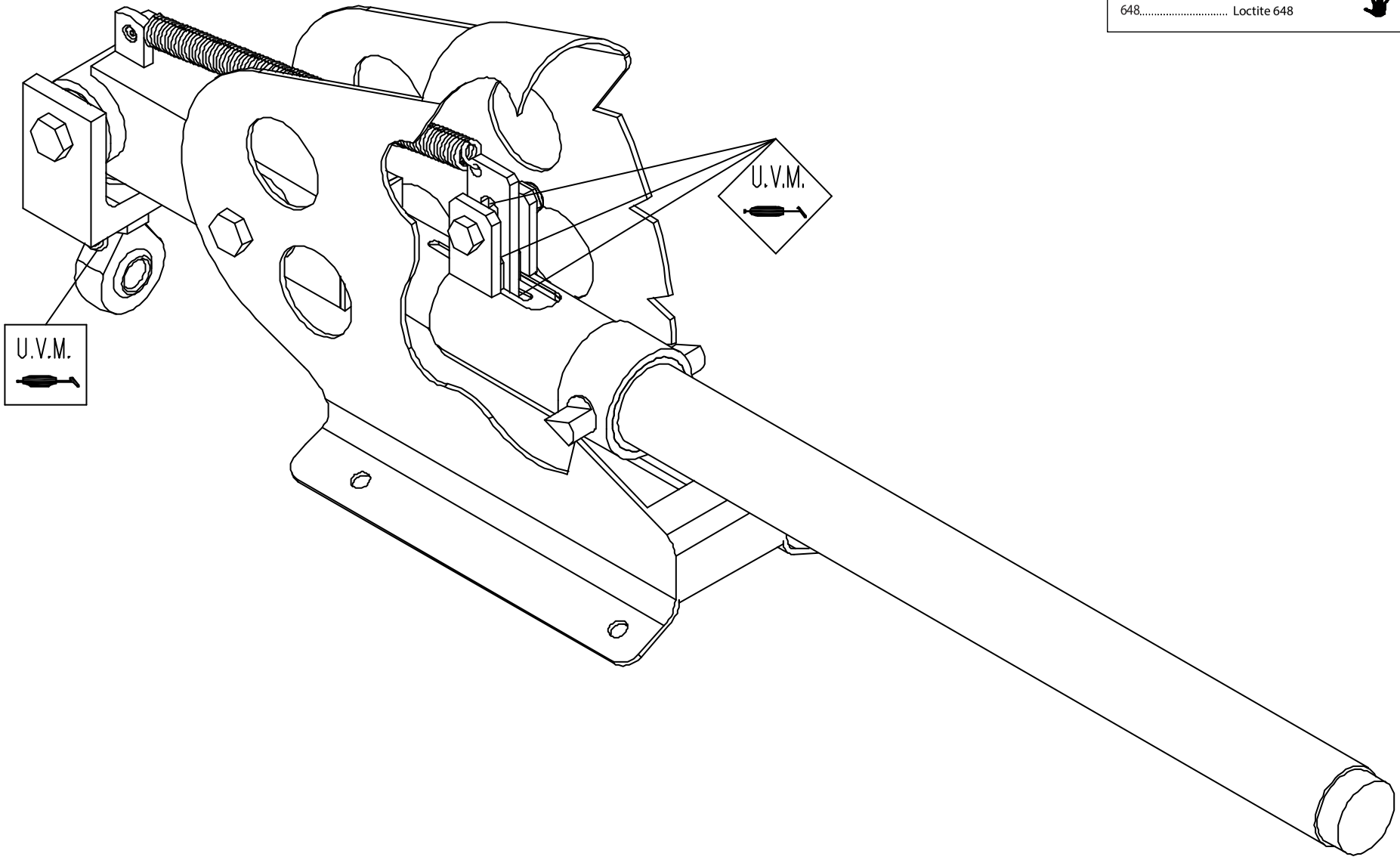
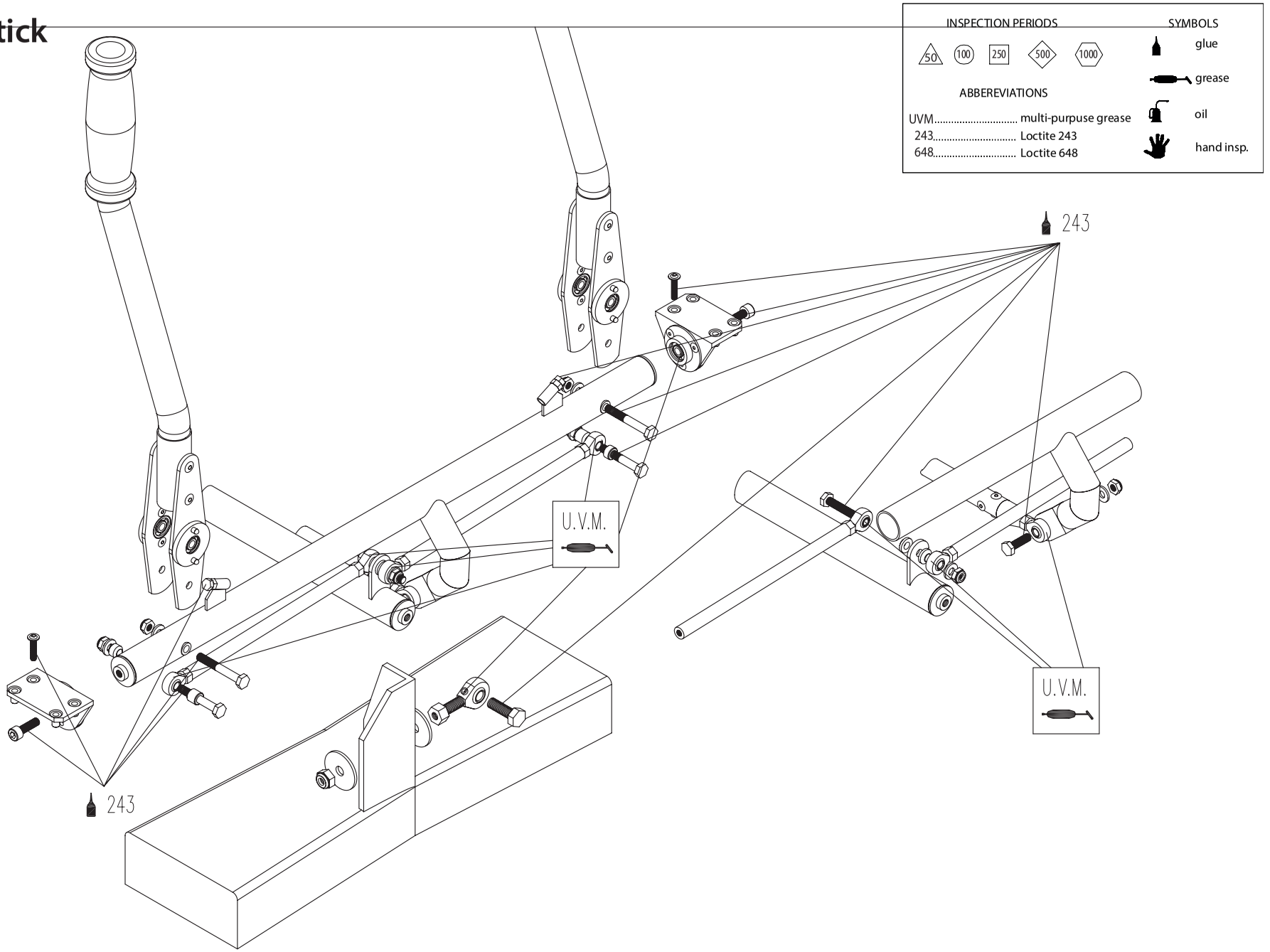
SYMBOLS

glue
grease
oil
hand insp.



Control stick



Rudder pedals

INSPECTION PERIODS

50 100 250 500 1000

ABBEREVIATIONS

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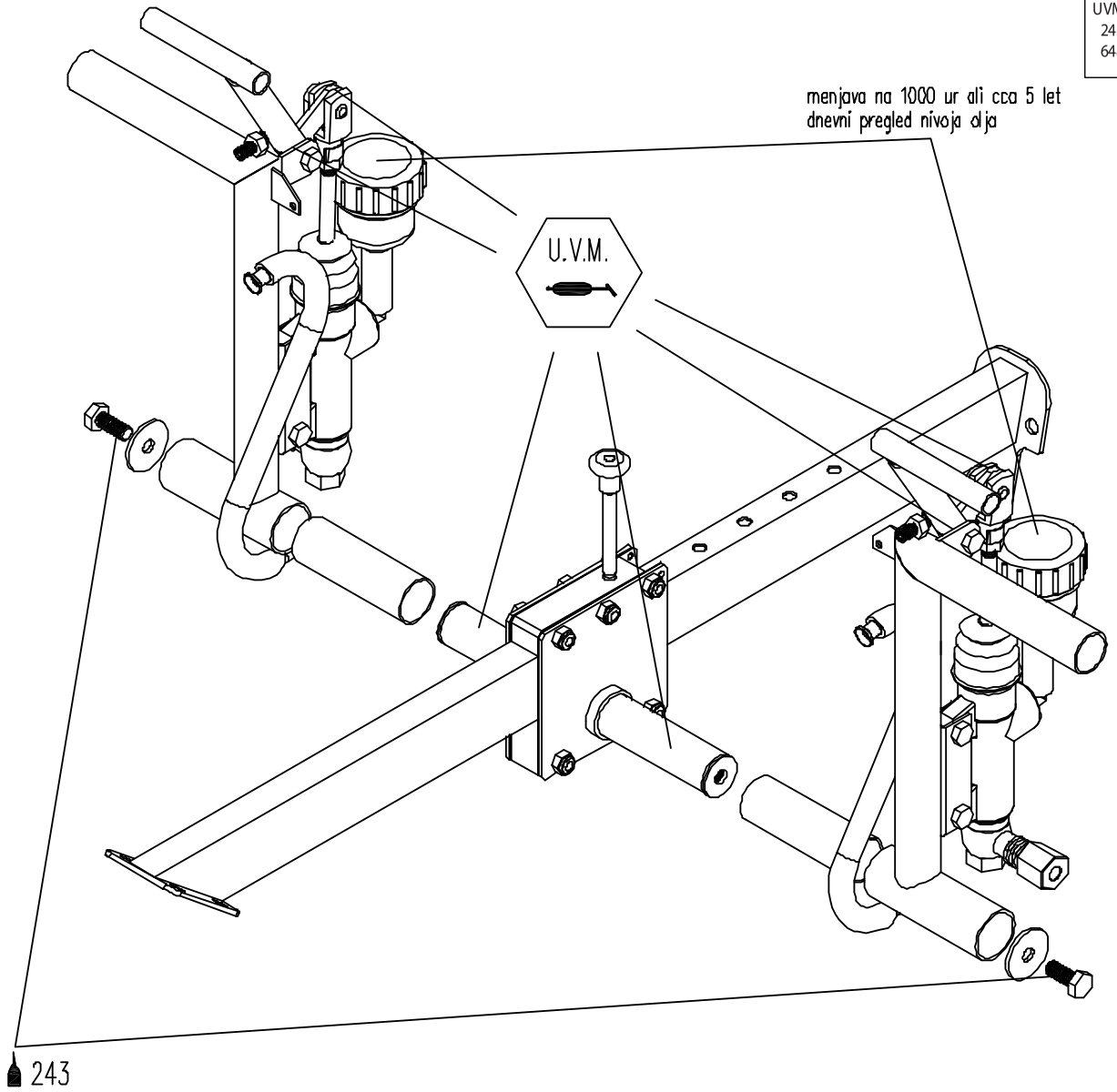
243..... Loctite 243
648..... Loctite 648

SYMBOLS

glue
grease
oil
hand insp.



Flap levers

INSPECTION PERIODS

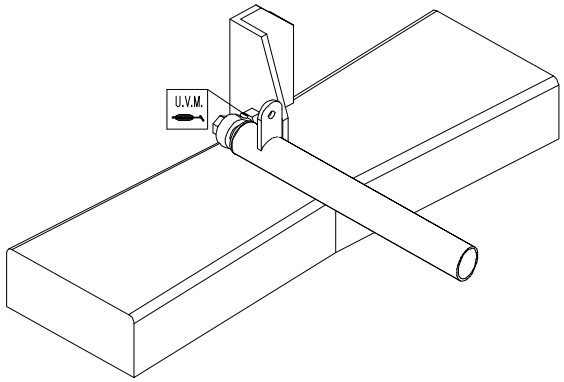
50 100 250 500 1000

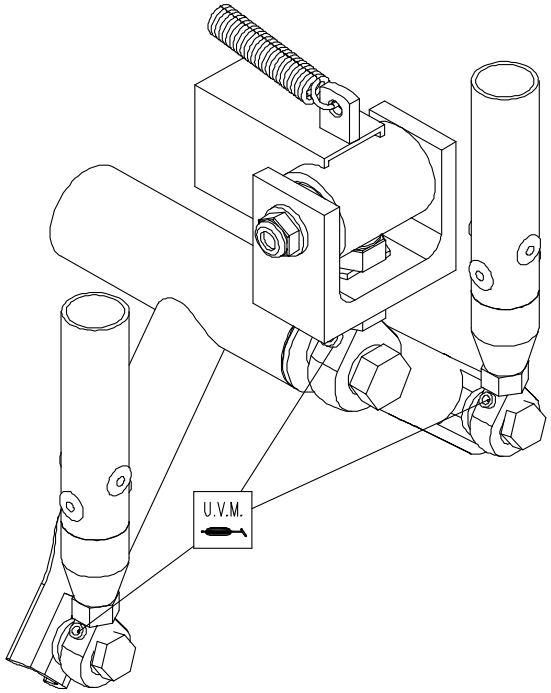
SYMBOLS

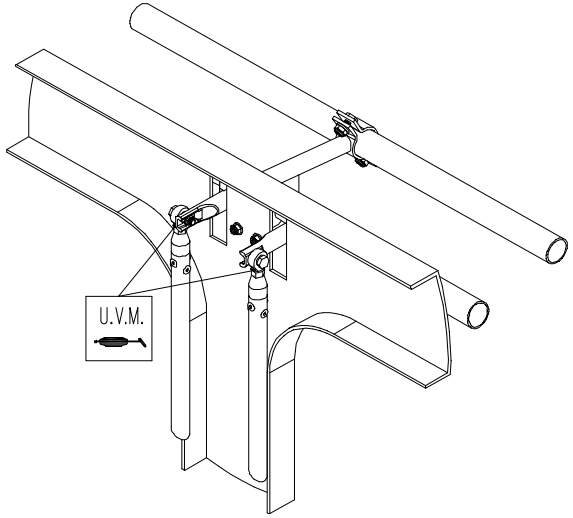
glue
grease
oil
hand insp.

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648







Wings

wing's exterior

INSPECTION PERIODS

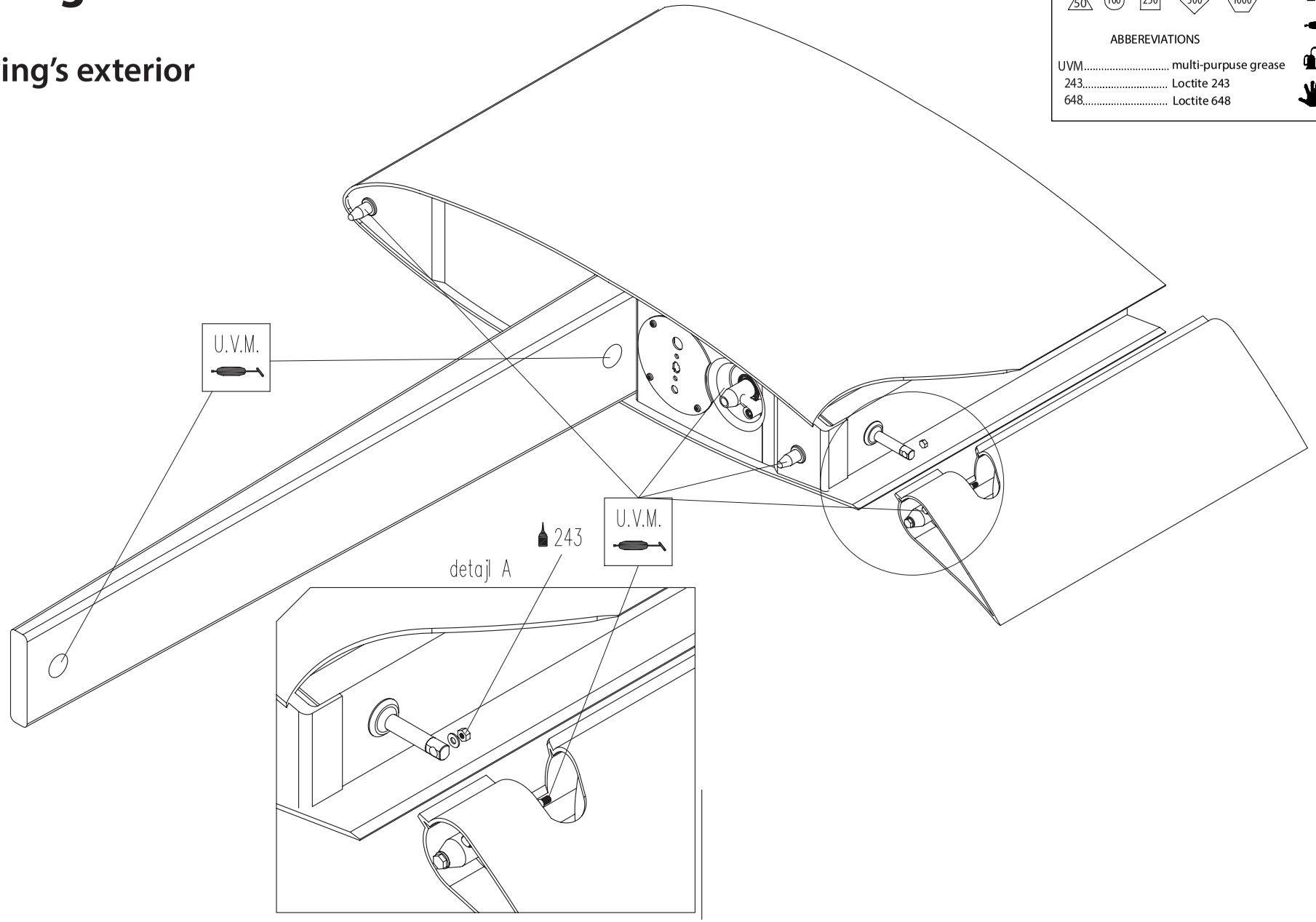
50 100 250 500 1000

ABBEREVIATIONS

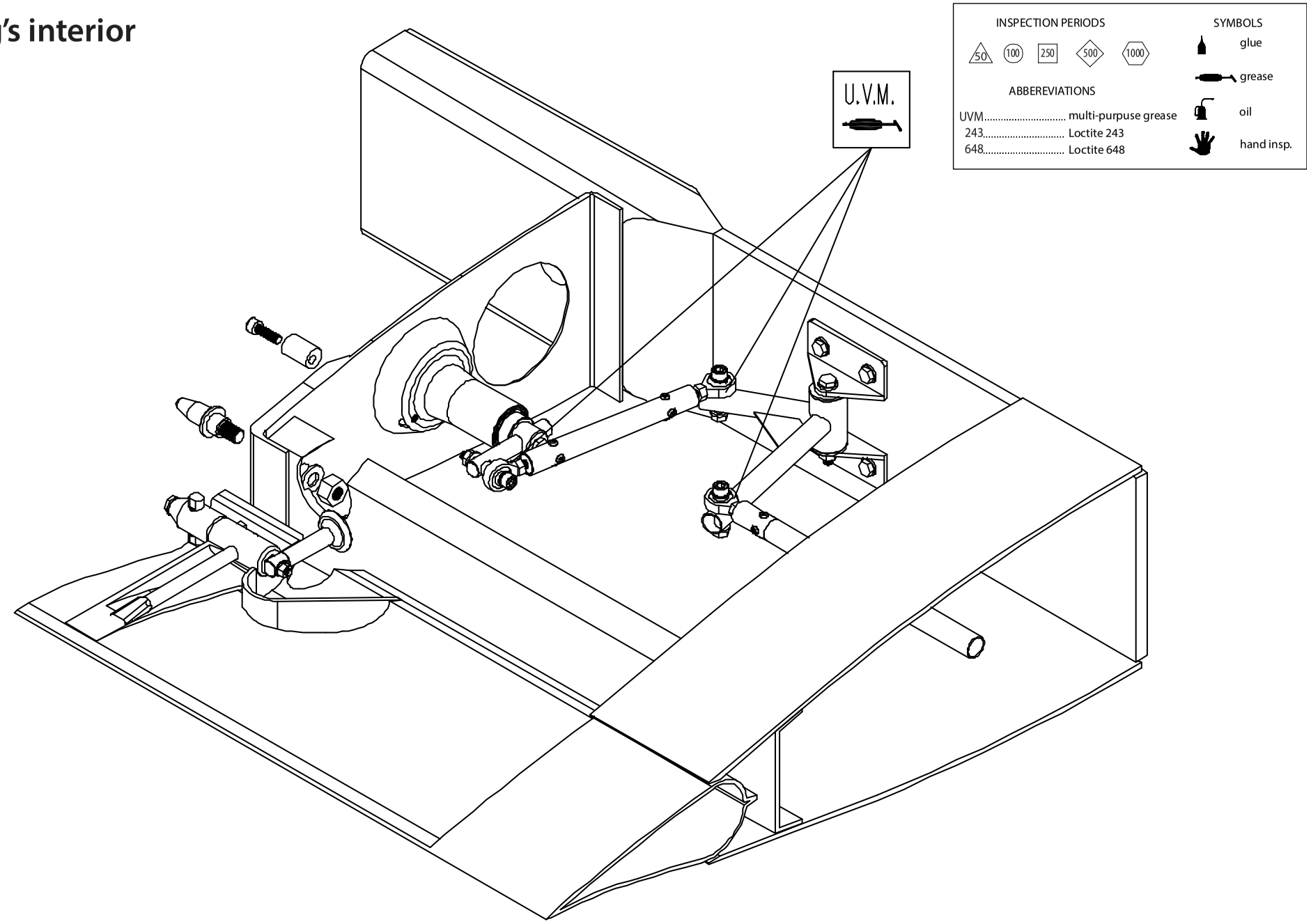
UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

SYMBOLS

glue
grease
oil
hand insp.



wing's interior



Airbrake - spoiler

INSPECTION PERIODS

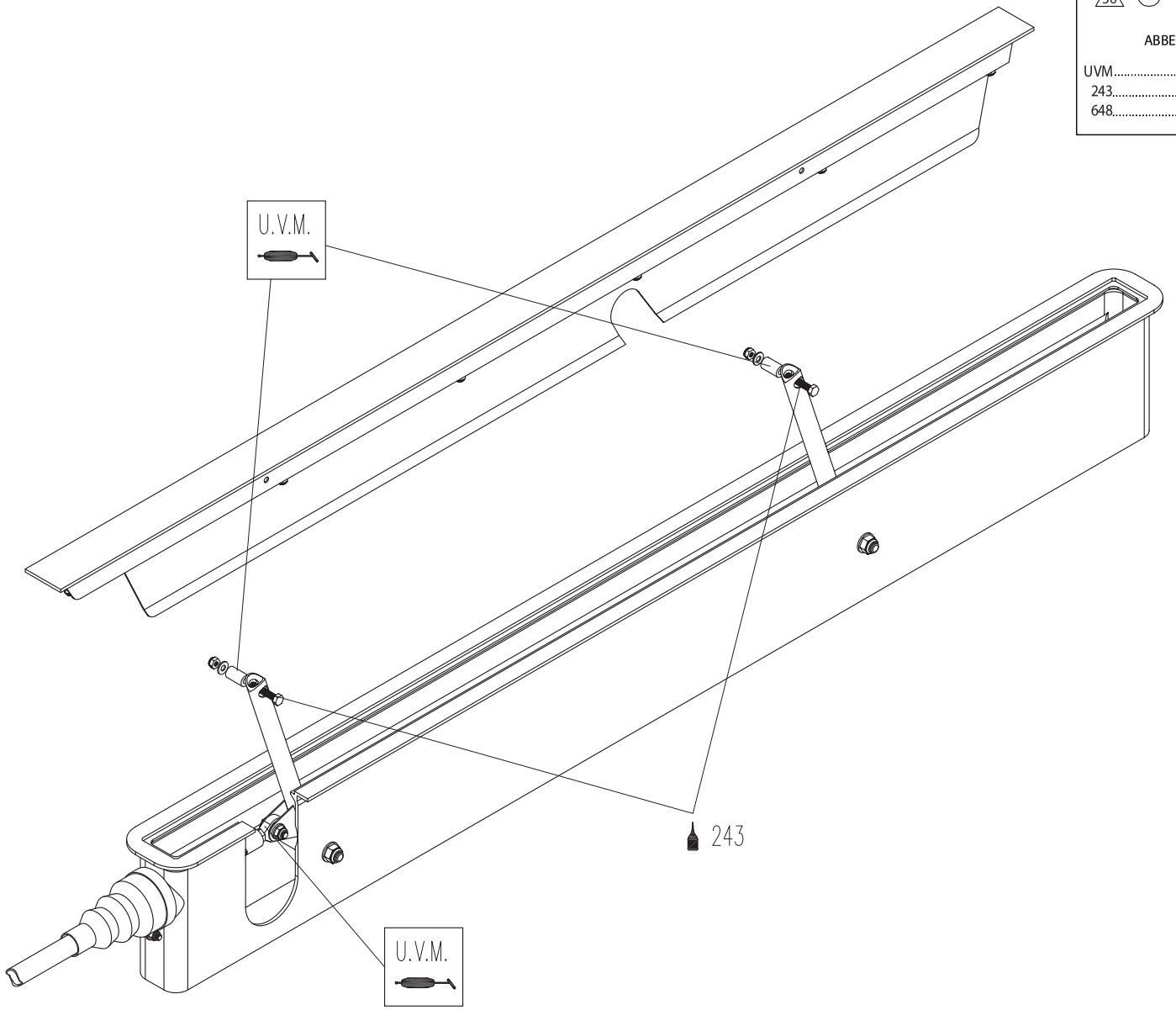
50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

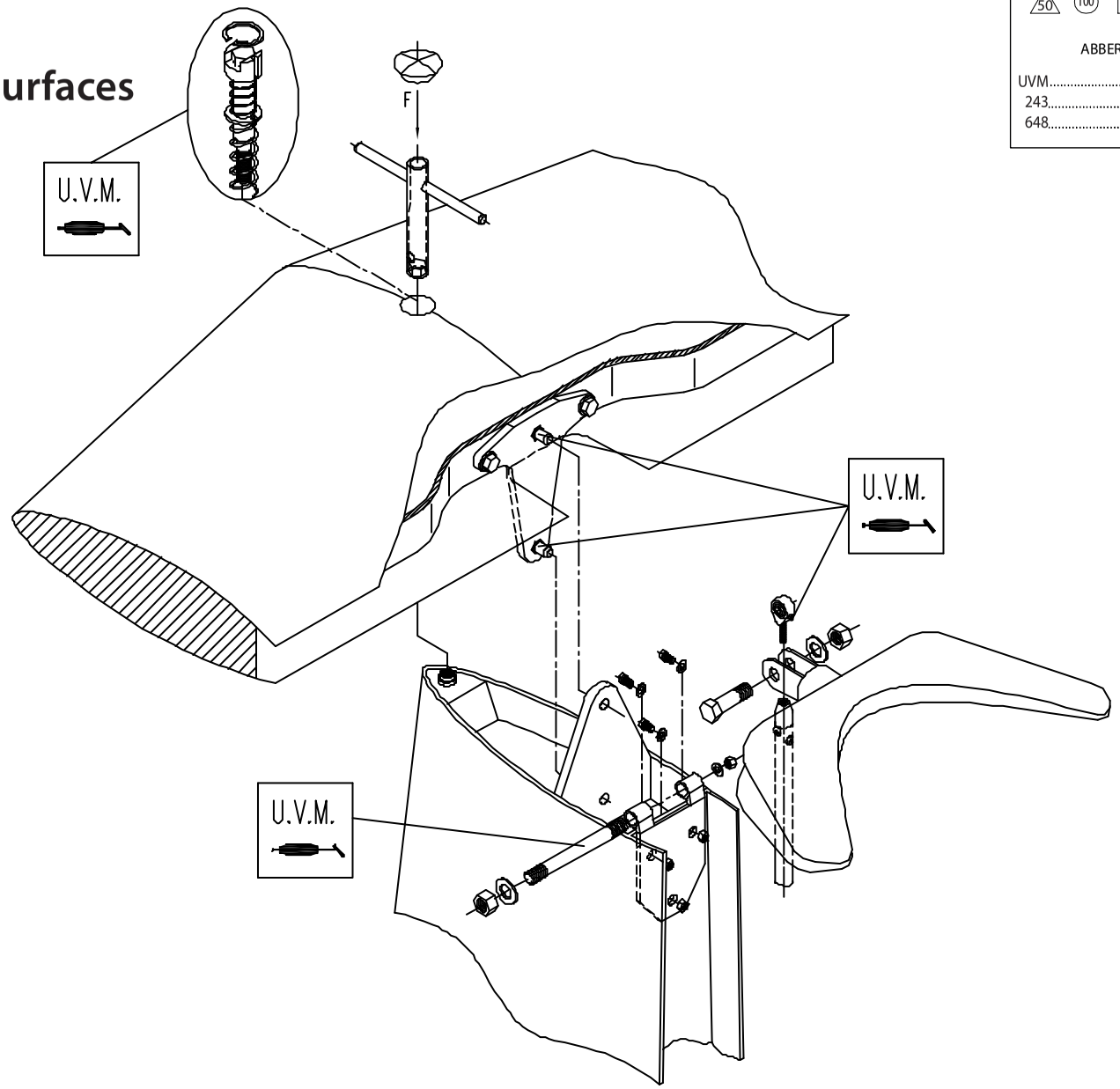
SYMBOLS

glue
grease
oil
hand insp.



Tail surfaces

horizontal tail surfaces



vertical tail surfaces

INSPECTION PERIODS

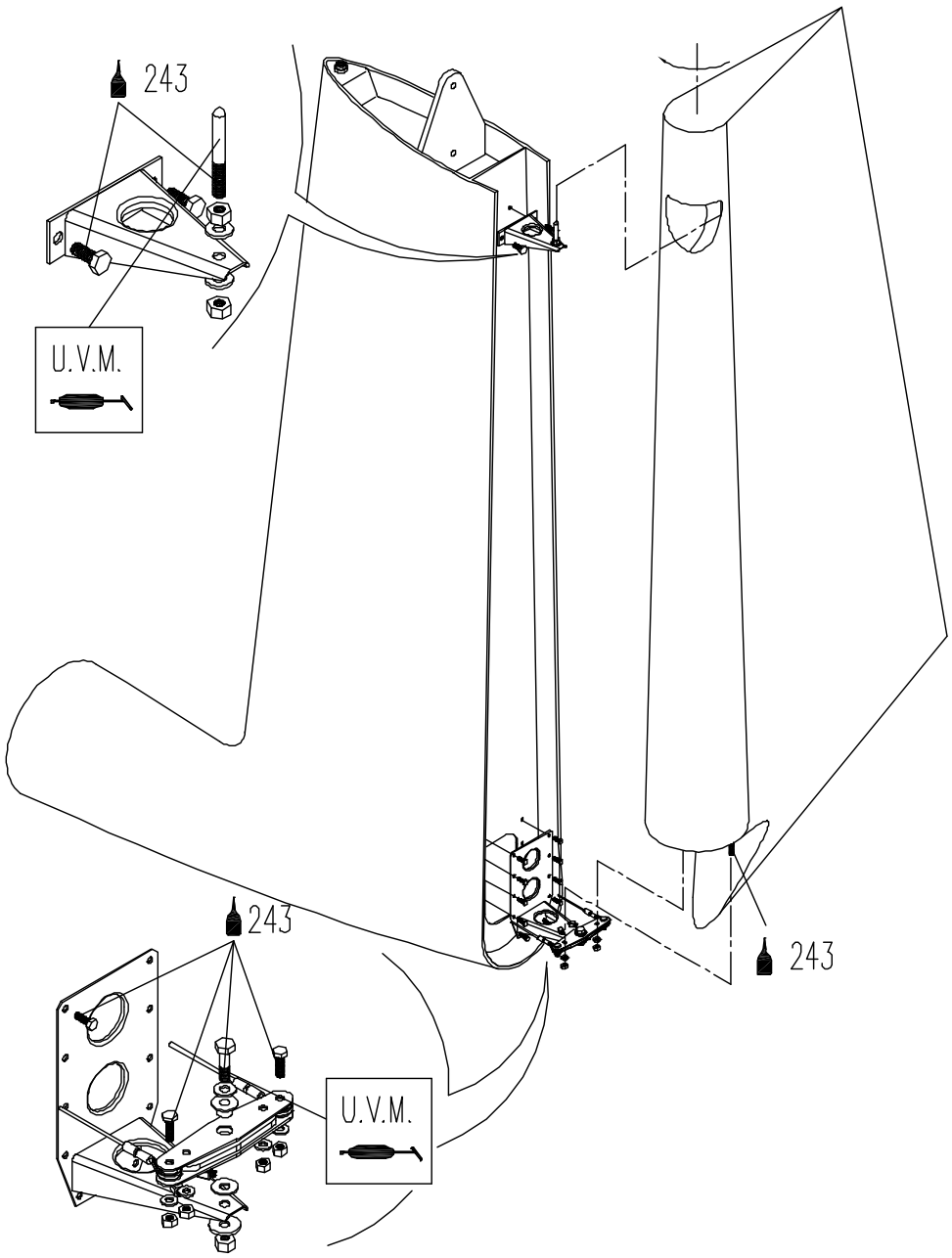
50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

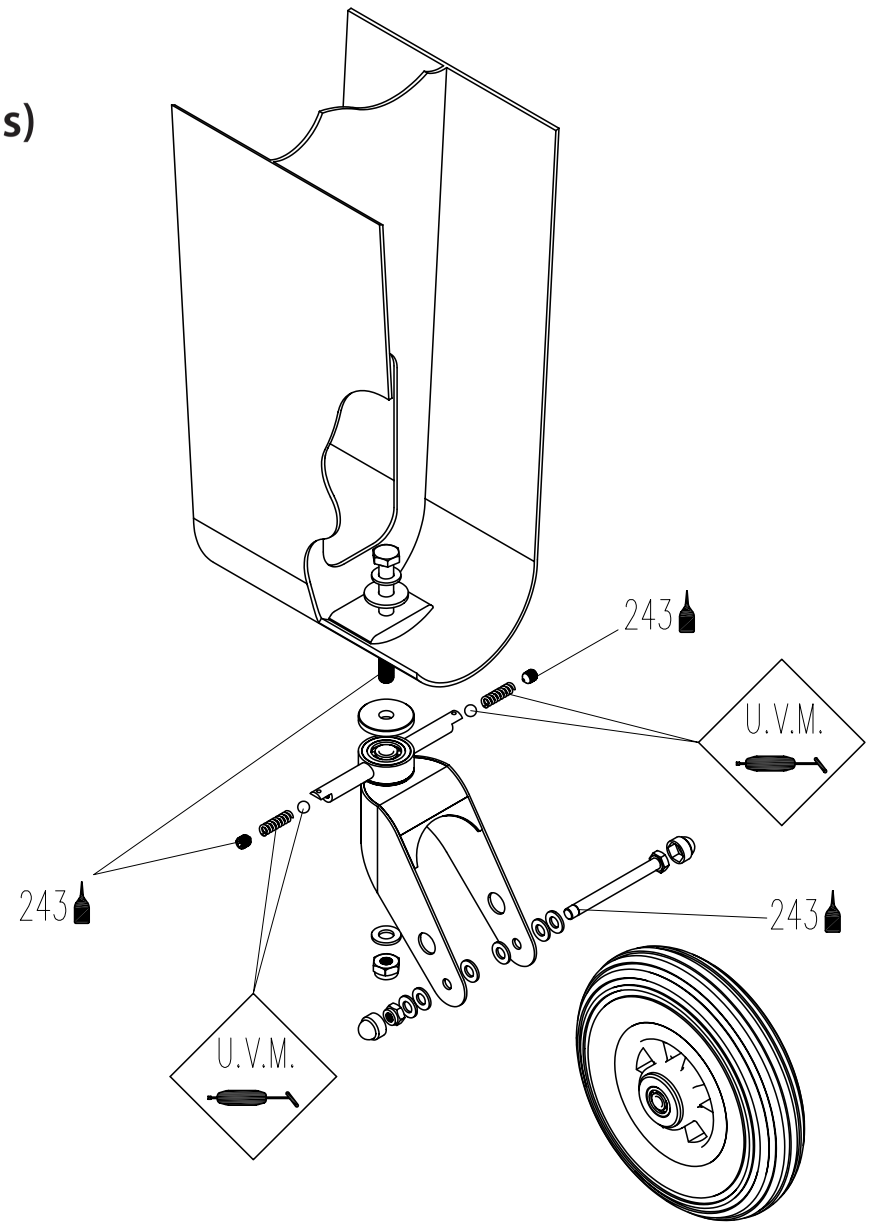
SYMBOLS

glue
grease
oil
hand insp.



Undercarriage

tail wheel (Sinus, all models)



INSPECTION PERIODS

50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

SYMBOLS

glue
grease
oil
hand insp.

Brakes

hydraulic brakes' drive

INSPECTION PERIODS

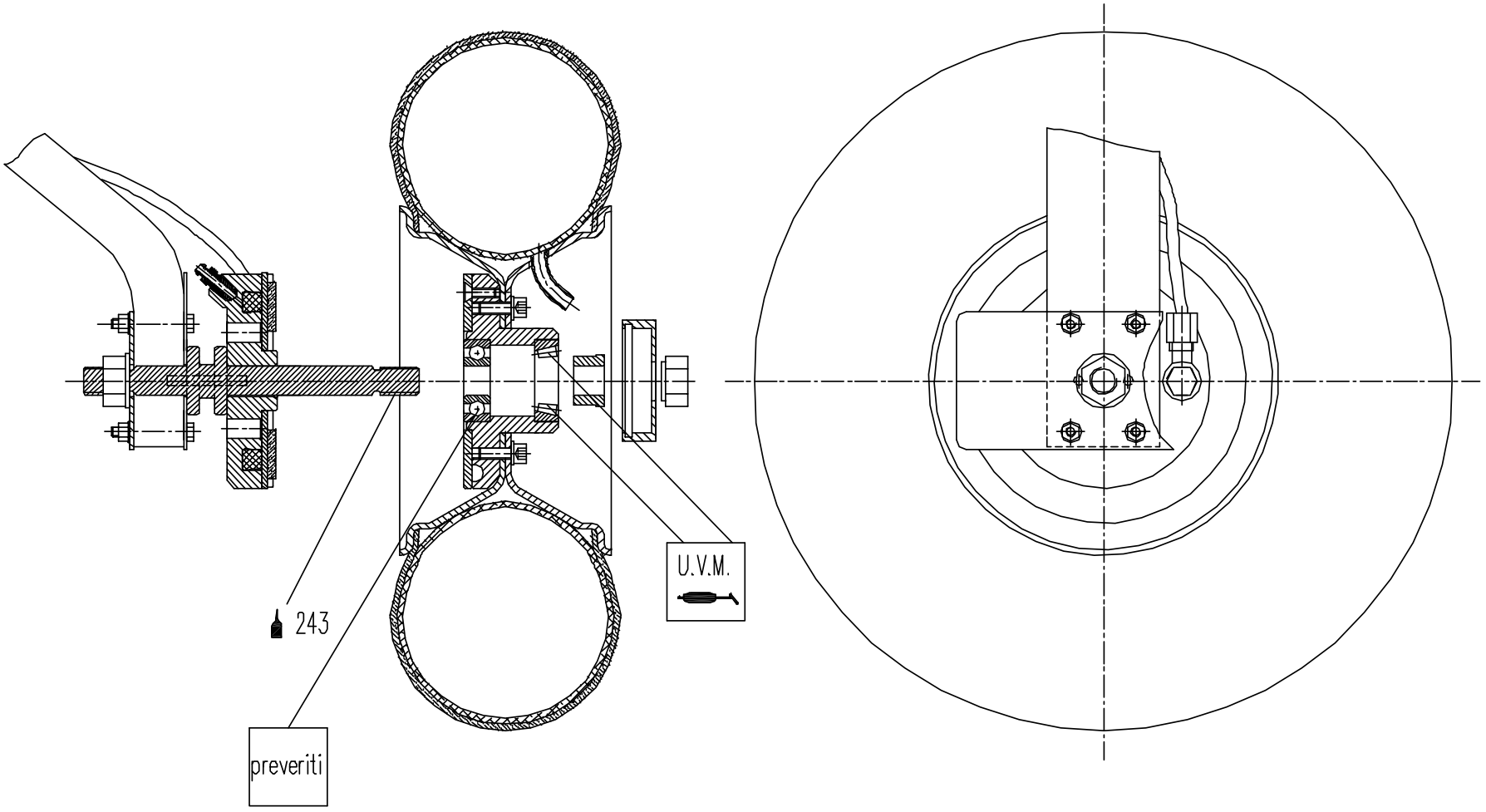
50 100 250 500 1000

ABBEREVIATIONS

UVM..... multi-purpuse grease
243..... Loctite 243
648..... Loctite 648

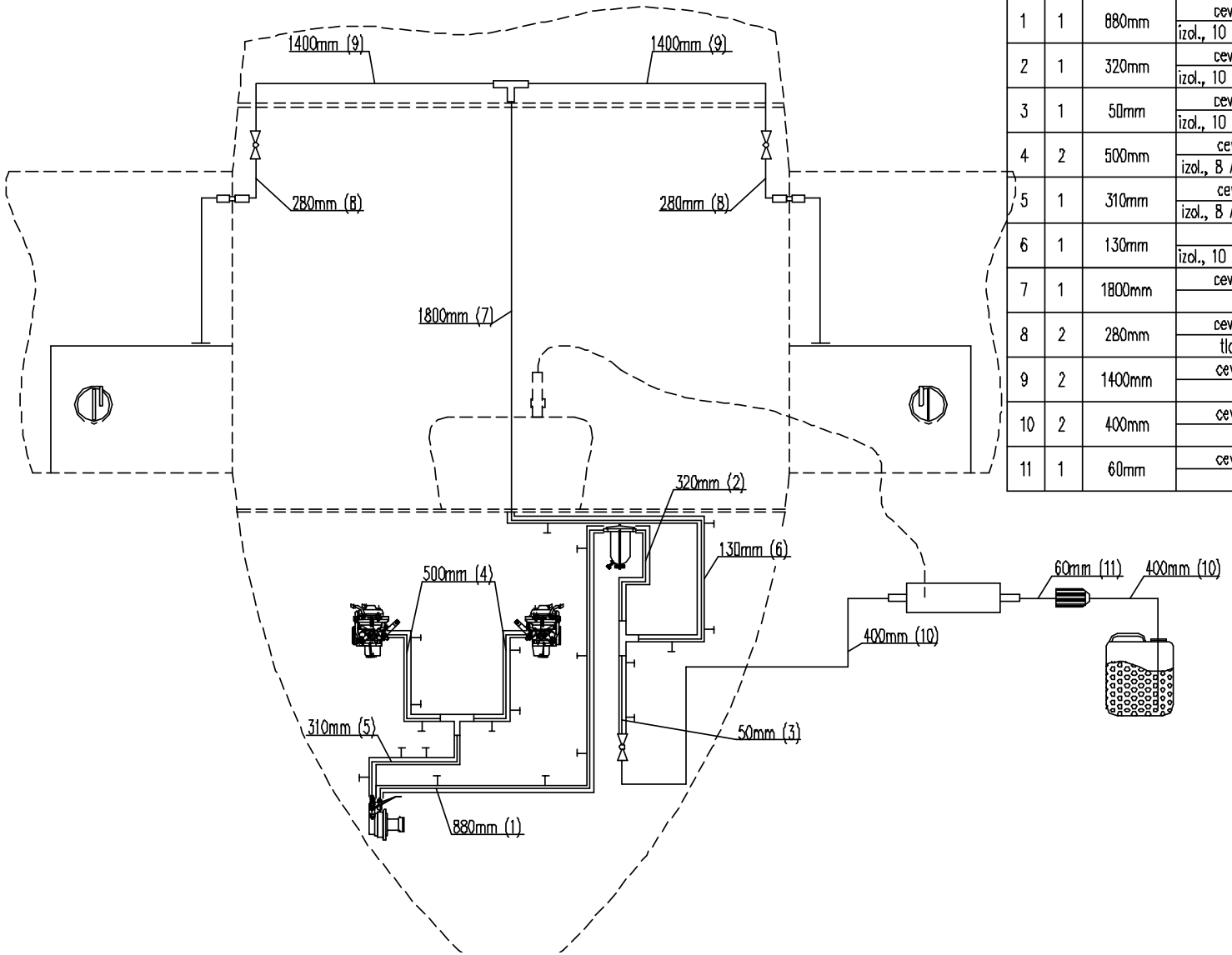
SYMBOLS

glue
grease
oil
hand insp.



Fuel system

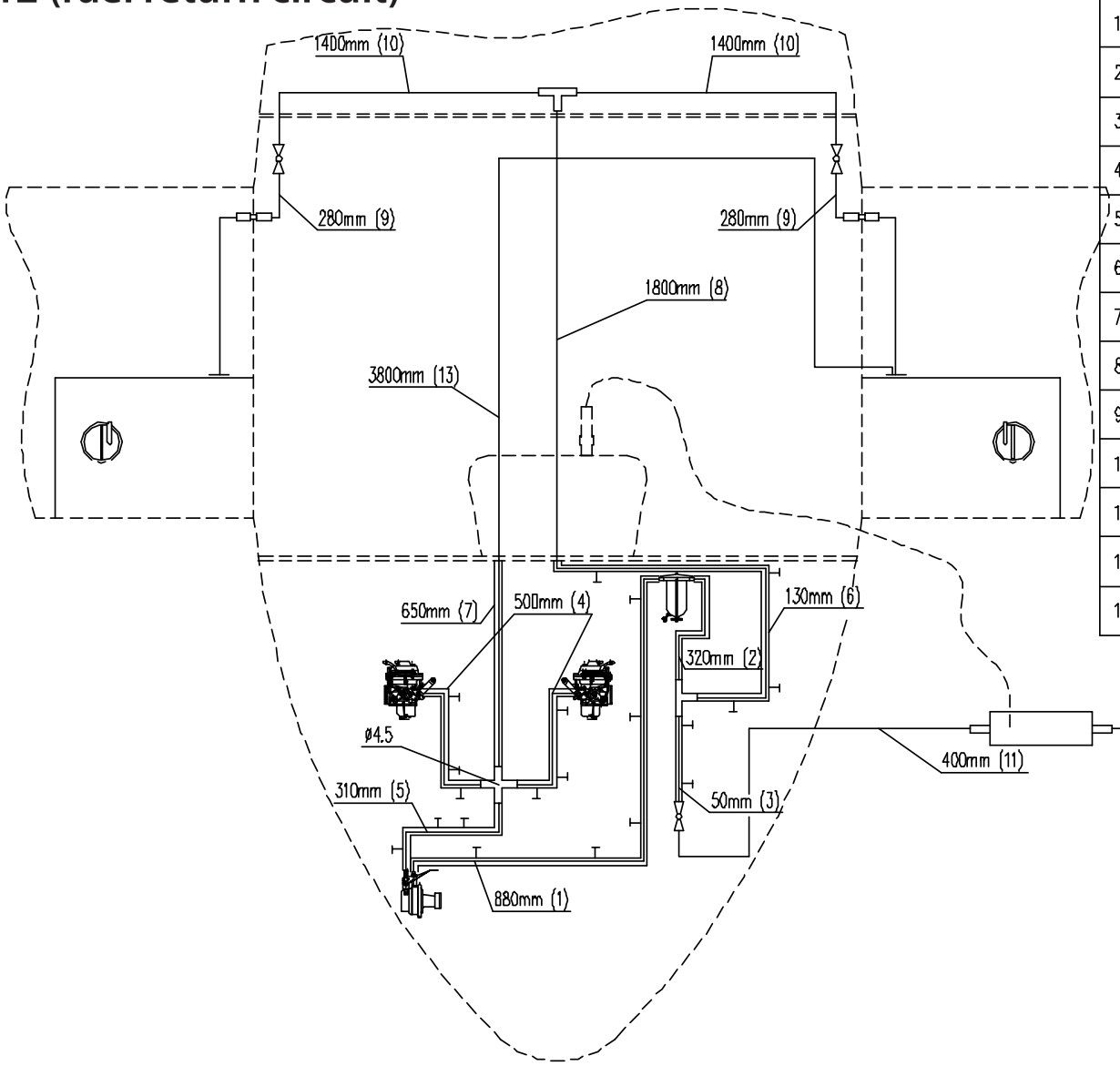
Rotax 912 (no fuel return circuit)



num.	qt.	lenght (l)	material
1	1	880mm	cev 5/16"SAE 30R7 (Goodyear)
			izol., 10 AS1072, Stratoflex 2650, (Parker)
2	1	320mm	cev 5/16"SAE 30R7 (Goodyear)
			izol., 10 AS1072, Stratoflex 2650, (Parker)
3	1	50mm	cev 5/16"SAE 30R7 (Goodyear)
			izol., 10 AS1072, Stratoflex 2650, (Parker)
4	2	500mm	cev 1/4"SAE 30R7 (Goodyear)
			izol., 8 AS1072, Stratoflex 2650, (Parker)
5	1	310mm	cev 1/4"SAE 30R7 (Goodyear)
			izol., 8 AS1072, Stratoflex 2650, (Parker)
6	1	130mm	
			izol., 10 AS1072, Stratoflex 2650, (Parker)
7	1	1800mm	cev 5/16"SAE 30R7 (Goodyear)
8	2	280mm	cev 5/16"SAE 30R7 (Goodyear)
			tlačna vzmet, d=1.2, D_z=7,
9	2	1400mm	cev CAVIS B, 7*12, PVC P, 9L
10	2	400mm	cev CAVIS B, 7*12, PVC P, 9L
11	1	60mm	cev CAVIS B, 7*12, PVC P, 9L

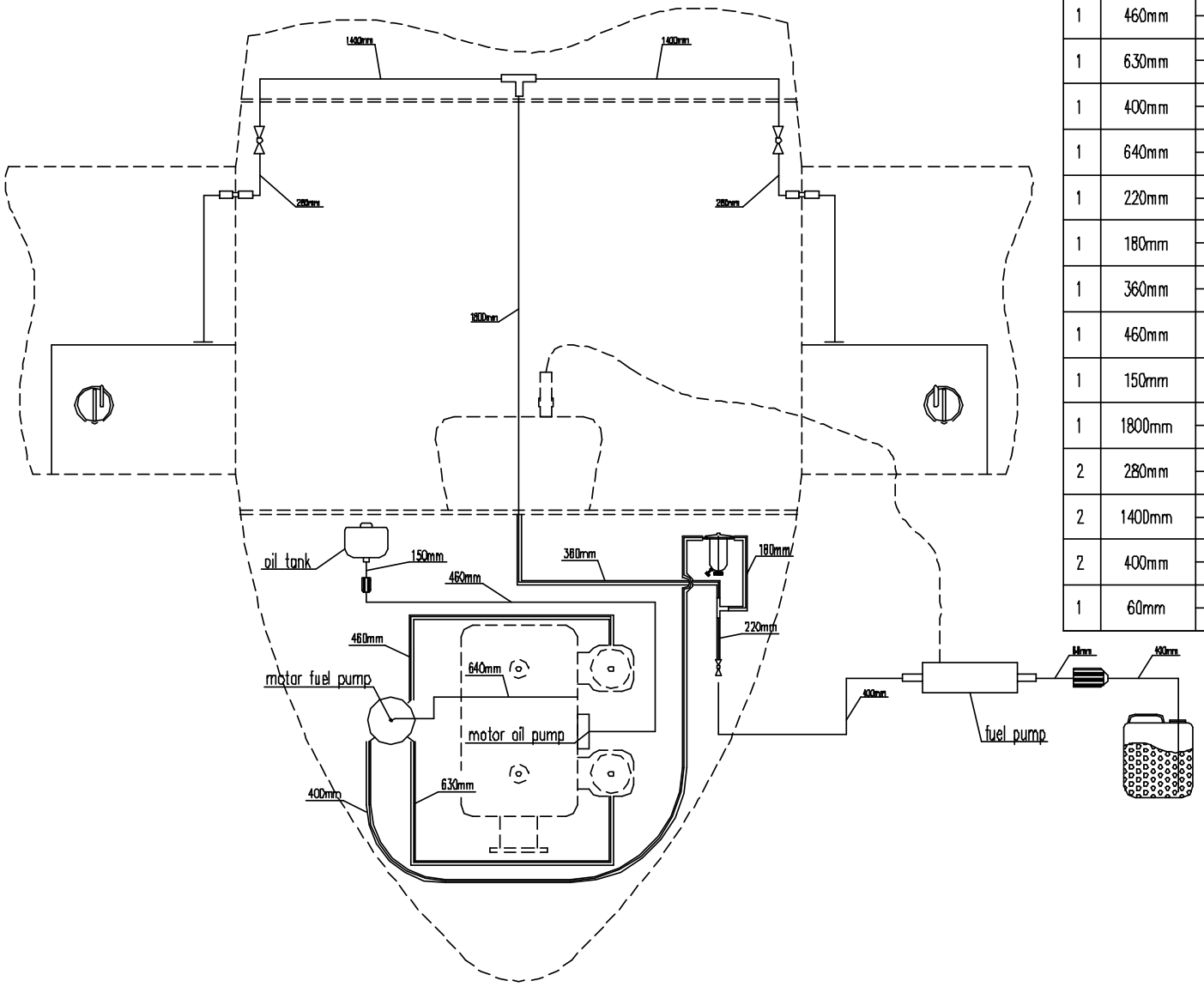
Fuel system

Rotax 912 (fuel return circuit)



num.	qt.	lenght (l)	material
1	1	880mm	cev 5/16"SAE 30R7 (Goodyear) izol., 10 AS1072, Stratoflex 2650, (Parker)
2	1	320mm	cev 5/16"SAE 30R7 (Goodyear) izol., 10 AS1072, Stratoflex 2650, (Parker)
3	1	50mm	cev 5/16"SAE 30R7 (Goodyear) izol., 10 AS1072, Stratoflex 2650, (Parker)
4	2	500mm	cev 1/4"SAE 30R7 (Goodyear) izol., 8 AS1072, Stratoflex 2650, (Parker)
5	1	310mm	cev 1/4"SAE 30R7 (Goodyear) izol., 8 AS1072, Stratoflex 2650, (Parker)
6	1	130mm	izol., 10 AS1072, Stratoflex 2650, (Parker)
7	1	650mm	izol., 8 AS1072, Stratoflex 2650, (Parker)
8	1	1800mm	cev 5/16"SAE 30R7 (Goodyear)
9	2	280mm	cev 5/16"SAE 30R7 (Goodyear) tlačna vzmet, d=1.2, D_2=7,
10	2	1400mm	cev CAVIS B, 7*12, PVC P, 9L
11	2	400mm	cev CAVIS B, 7*12, PVC P, 9L
12	1	60mm	cev CAVIS B, 7*12, PVC P, 9L
13	1	3800mm	cev CAVIS B, 5*9, PVC P, 18

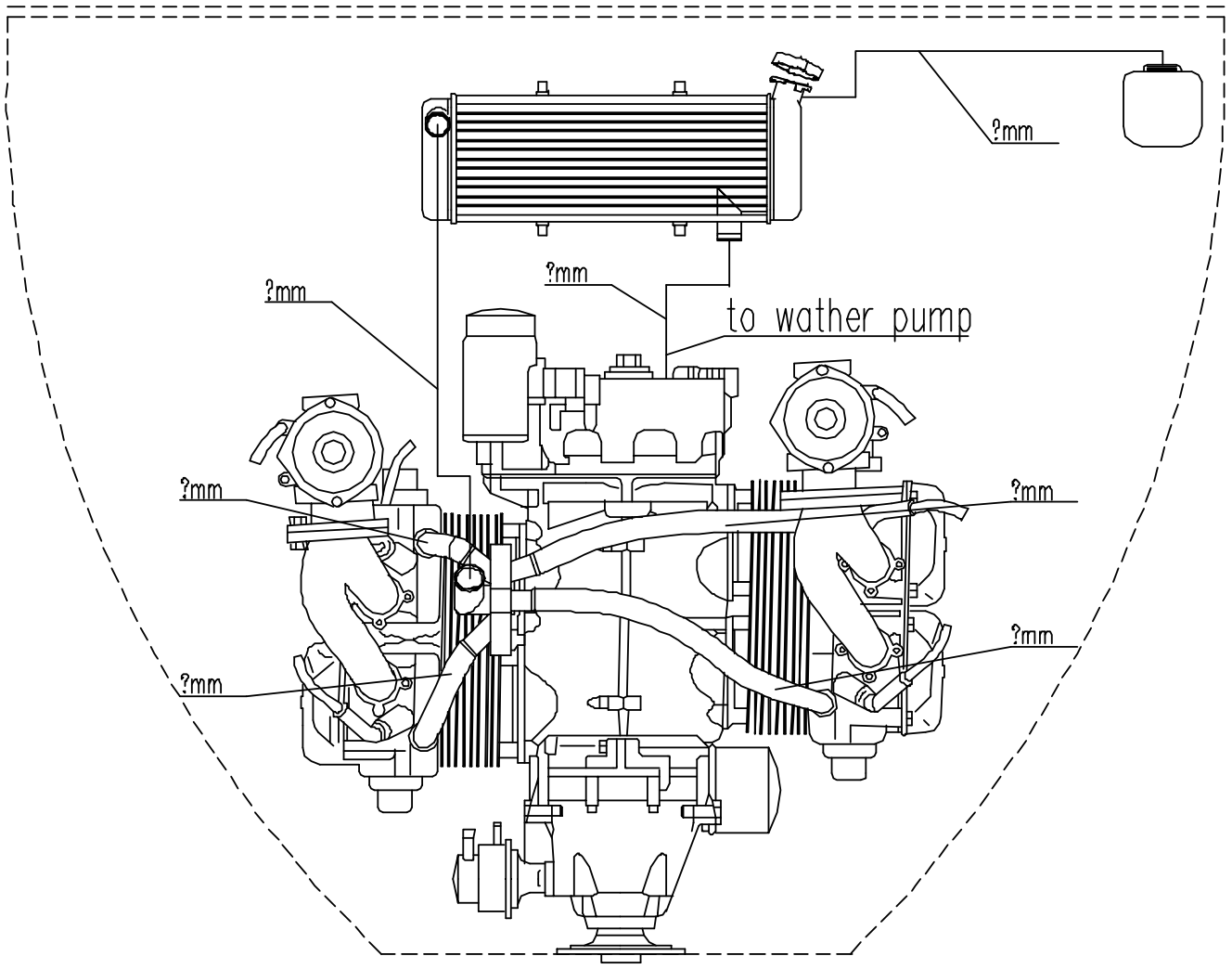
Rotax 582



kol.	lenght (l)	material
1	460mm	tube 1/4"SAE 30R7 (Goodyear)
		8 AS1072, Stratoflex 2650, (Parker)
1	630mm	tube 1/4"SAE 30R7 (Goodyear)
		8 AS1072, Stratoflex 2650, (Parker)
1	400mm	tube 1/4"SAE 30R7 (Goodyear)
		8 AS1072, Stratoflex 2650, (Parker)
1	640mm	tube 1/4"SAE 30R7 (Goodyear)
1	220mm	tube 5/16"SAE 30R7 (Goodyear)
		10 AS1072, Stratoflex 2650, (Parker)
1	180mm	tube 5/16"SAE 30R7 (Goodyear)
		10 AS1072, Stratoflex 2650, (Parker)
1	360mm	tube 5/16"SAE 30R7 (Goodyear)
		10 AS1072, Stratoflex 2650, (Parker)
1	460mm	tube ø9, gumijasta, aplaščena s tkanino
1	150mm	tube ø9, gumijasta, aplaščena s tkanino
1	1800mm	tube 5/16"SAE 30R7 (Goodyear)
2	280mm	tube 5/16"SAE 30R7 (Goodyear)
2	1400mm	cev CAVIS B, 7*12, PVC P, 9L
2	400mm	tube CAVIS B, 7*12, PVC P, 9L
1	60mm	tube CAVIS B, 7*12, PVC P, 9L

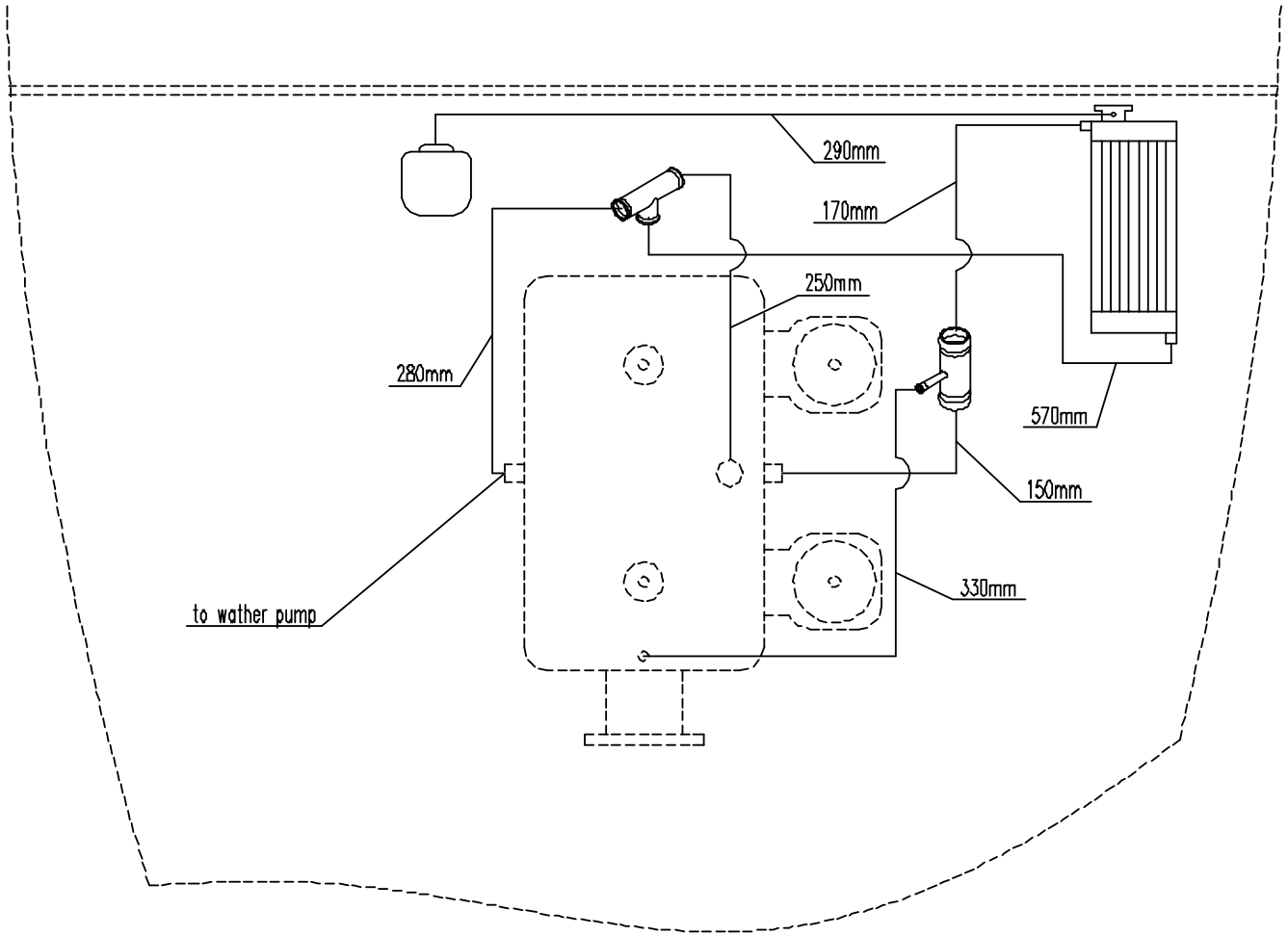
Engine cooling system

Rotax 912



kol.	dolžina (l)	material
1	65mm	D=Ø34mm; d=Ø25mm; armirana z žico
1	110mm	D=Ø34mm; d=Ø25mm; armirana z žico
1	260mm	D=Ø34mm; d=Ø25mm; armirana z žico
1	700mm	D=Ø34mm; d=Ø25mm; armirana z žico
1	130mm	DIN 73411
2	190mm	DIN 73411
1	200mm	DIN 73411
1	960mm	cev CAVIS B, 5*9, PVC P

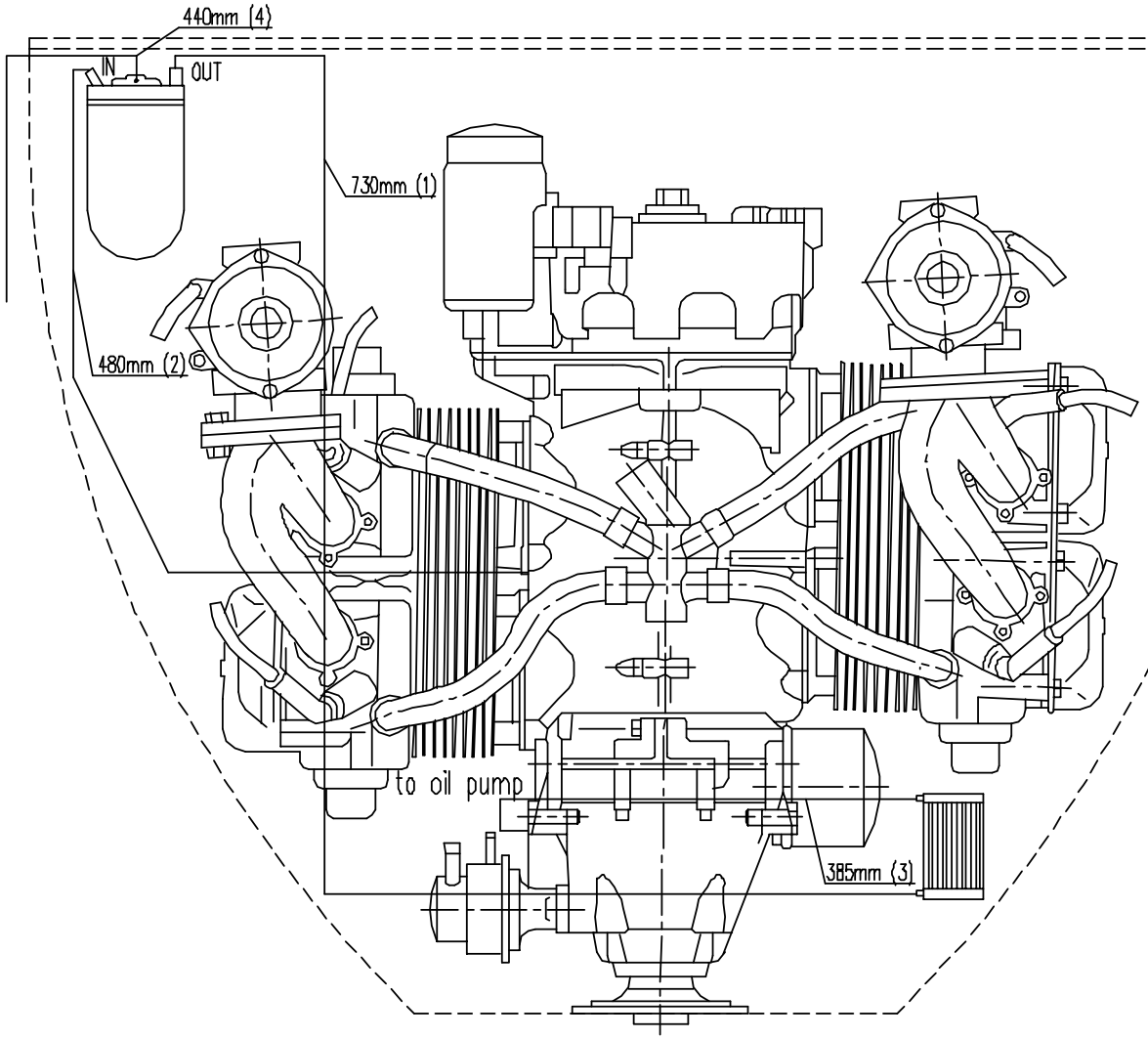
Rotax 582



kol.	lenght (l)	material
1	570mm	D=Ø34mm; d=Ø25mm; reinforca with steel
1	150mm	D=Ø34mm; d=Ø25mm; reinforca with steel
1	170mm	D=Ø34mm; d=Ø25mm; reinforca with steel
1	280mm	original ROTAX tube
1	250mm	original ROTAX tube
1	290mm	tube CAVIS EI, 5*9, PVC P
1	330mm	tube CAVIS EI, 5*9, PVC P

Engine lubrication system

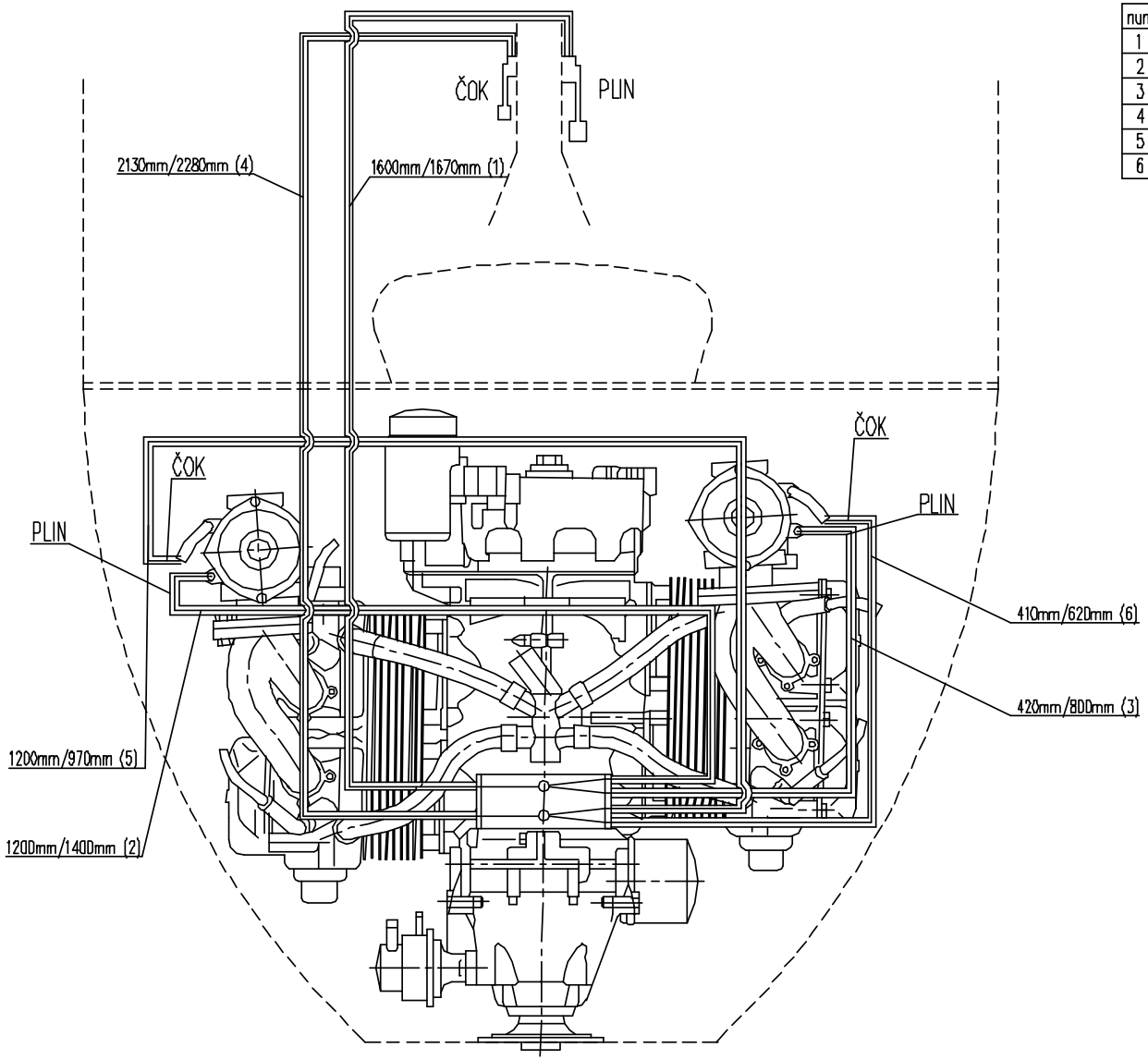
Rotax 912



num.	qt.	lenght	material
1	1	730mm	CONTI, TCH, OLNS, 1, 12*3.5, 01/00
2	1	480mm	CONTI, TCH, OLNS, 1, 12*3.5, 01/00
3	1	385mm	Aeroqip GH663 -8 DN 12/175bar/2500psi EN 853/1SN/12/2000MSHA IC-84/22
4	1	440mm	tube CAVIS B, 7*12, PVC, 9L

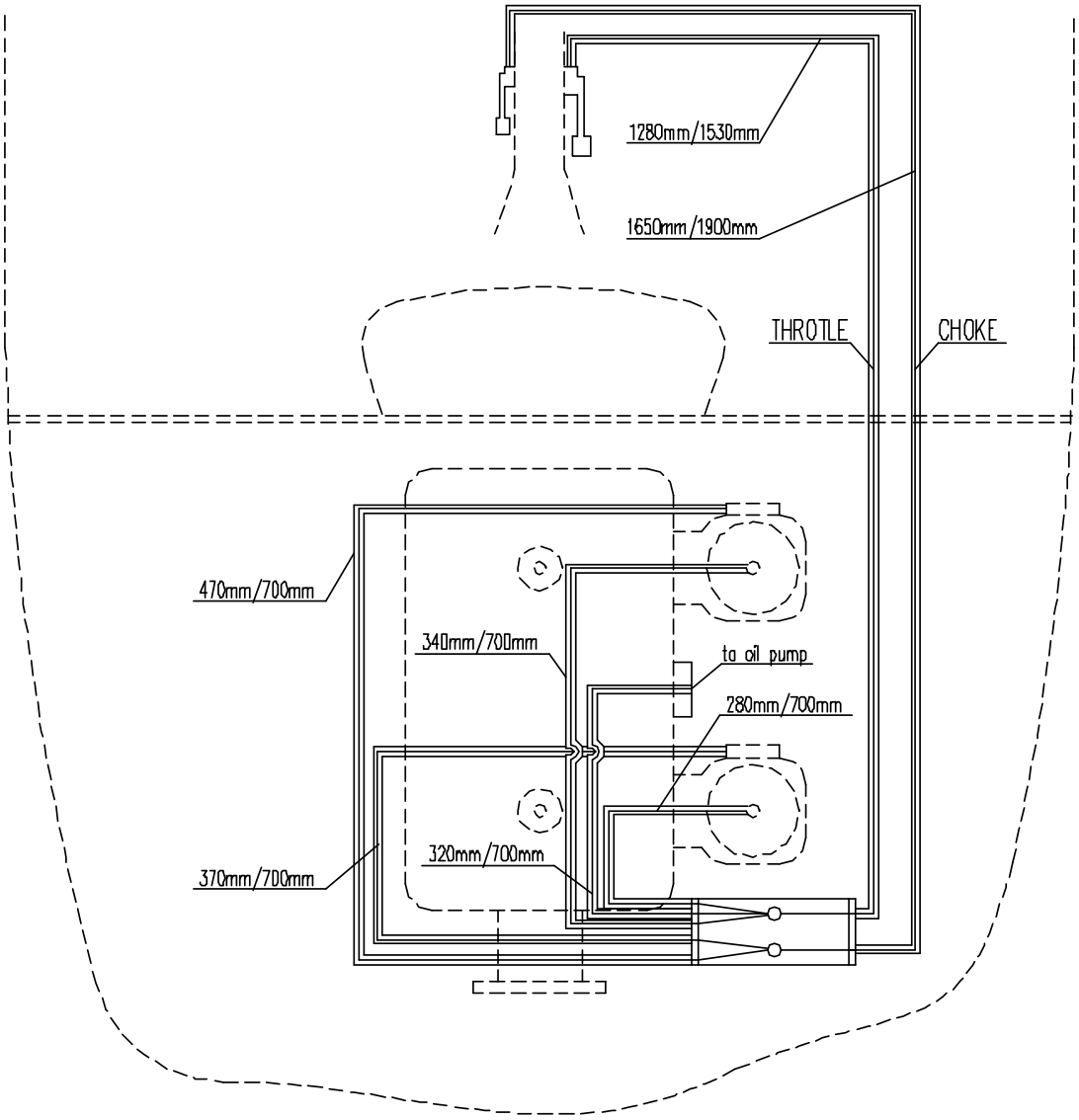
Throttle and choke drive

Rotax 912



num.	qt.	bowden lenght/cable lenght	bowden/cable
1	1	1600mm/1670mm	za plet. ø1.2mm/ø1.2mm
2	1	1200mm/1400mm	za plet. ø1.2mm/ø1.2mm
3	1	420mm/800mm	za plet. ø1.2mm/ø1.2mm
4	1	2130mm/2280mm	za plet. ø1.2mm/ø1.2mm
5	1	1200mm/970mm	za plet. ø1.2mm/ø1.2mm
6	1	410mm/620mm	za plet. ø1.2mm/ø1.2mm

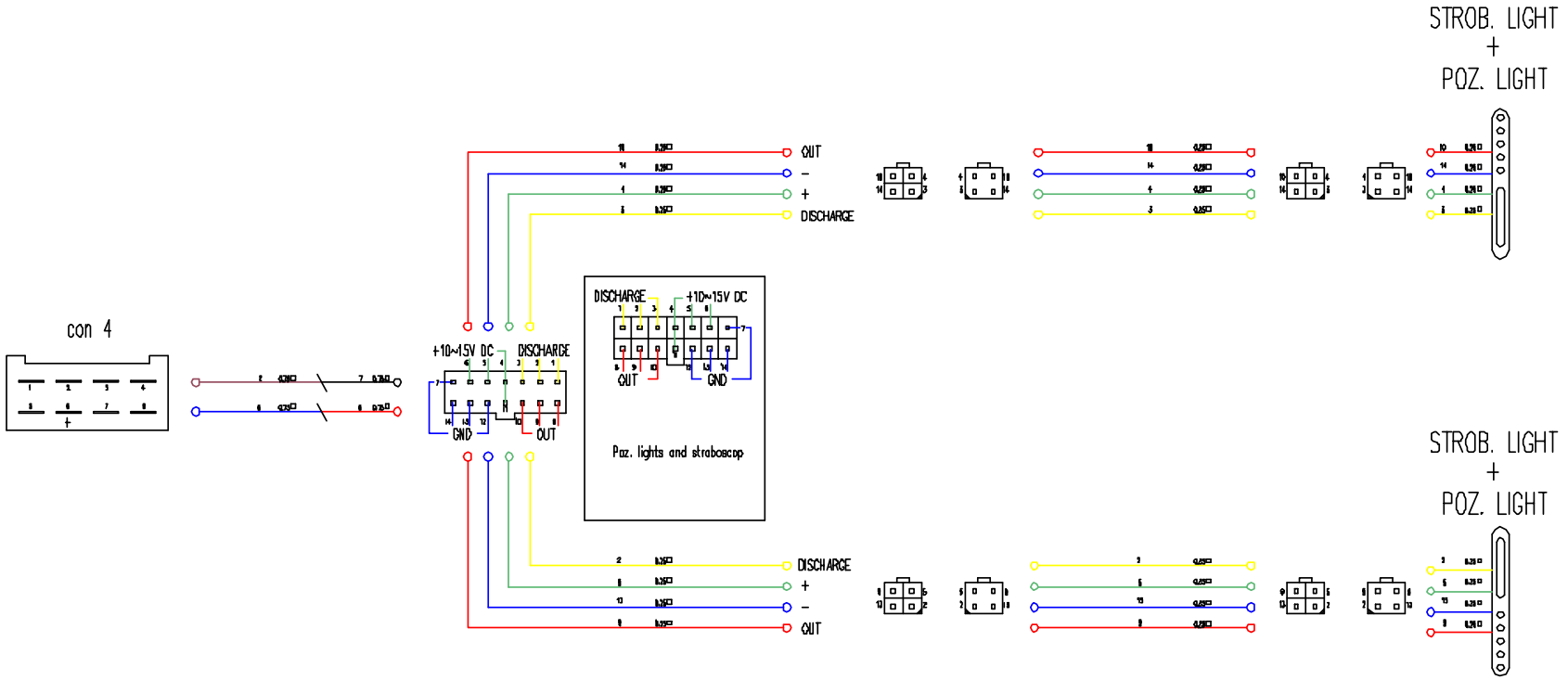
Rotax 582



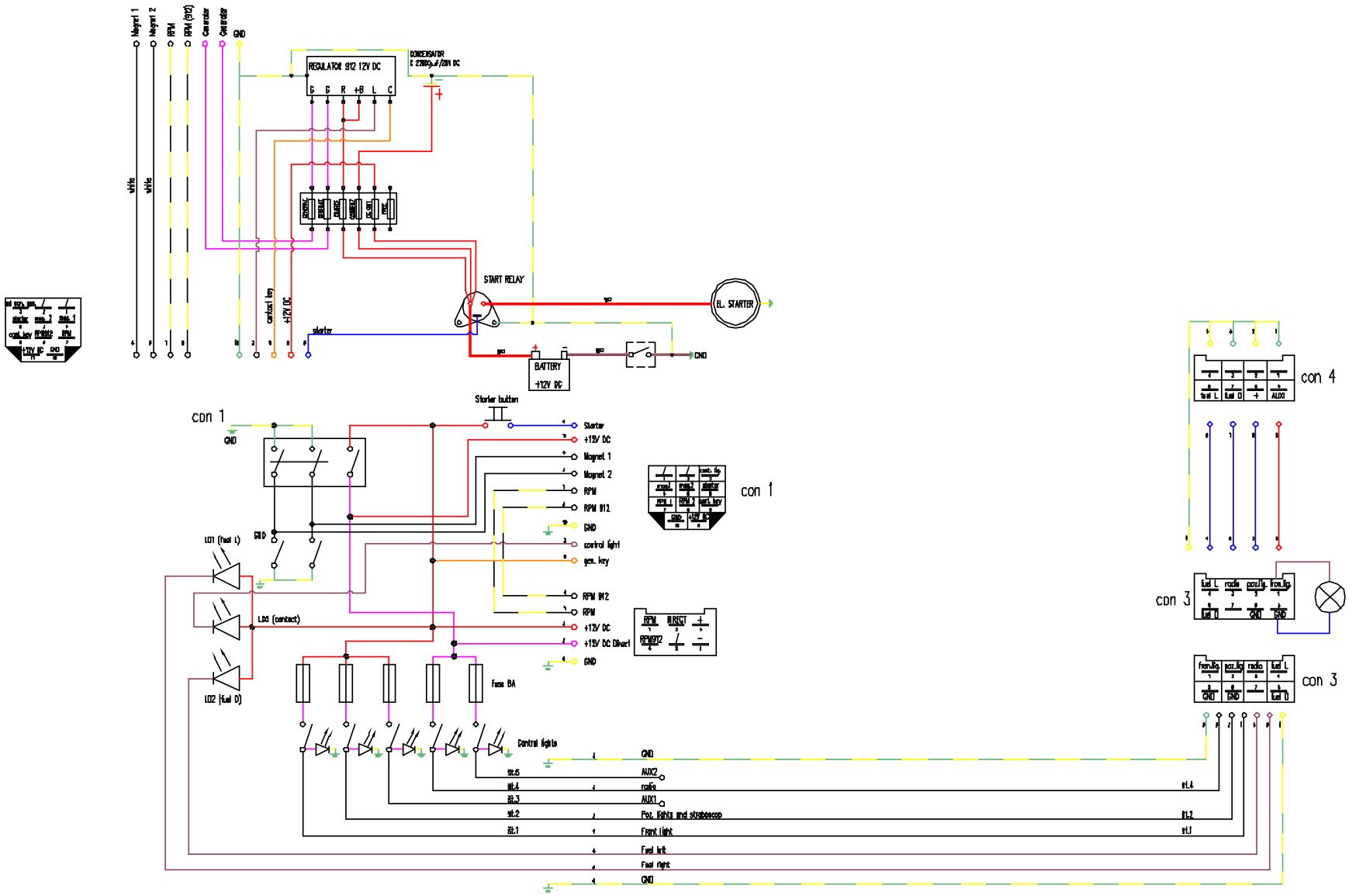
qt.	bowden lenght/cable lenght	bpwden/cable
1	470mm/700mm	za plet. ϕ1.2mm/ϕ1.2mm
1	370mm/700mm	za plet. ϕ1.2mm/ϕ1.2mm
1	280mm/700mm	za plet. ϕ1.2mm/ϕ1.2mm
1	320mm/700mm	za plet. ϕ1.2mm/ϕ1.2mm
1	340mm/700mm	za plet. ϕ1.2mm/ϕ1.2mm
1	1280mm/1530mm	za plet. ϕ1.2mm/ϕ1.2mm
1	1650mm/1900mm	za plet. ϕ1.2mm/ϕ1.2mm

Electrical system

NAV lights & strobes



electrical circuit



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Repairs

Elevator vertical pushrod replacement

VARIO Propeller Assembly

VARIO Propeller Drive Replacement

VARIO Propeller Bearing Replacement

3-Bladed Fixed Pitch Propeller

Airbrake Control's Drive Reinforcement (1)

Airbrake Control's Drive Reinforcement (2)

Flaperon Hinge Replacement

Flaperon Lateral Drive Assembly

Flaperon Mass Balance Weights Installation

Wheel Brake (cockpit side) Assembly

Hydraulic Fluid Lines Assembly (wheel side)

Airbrake Handle Assembly

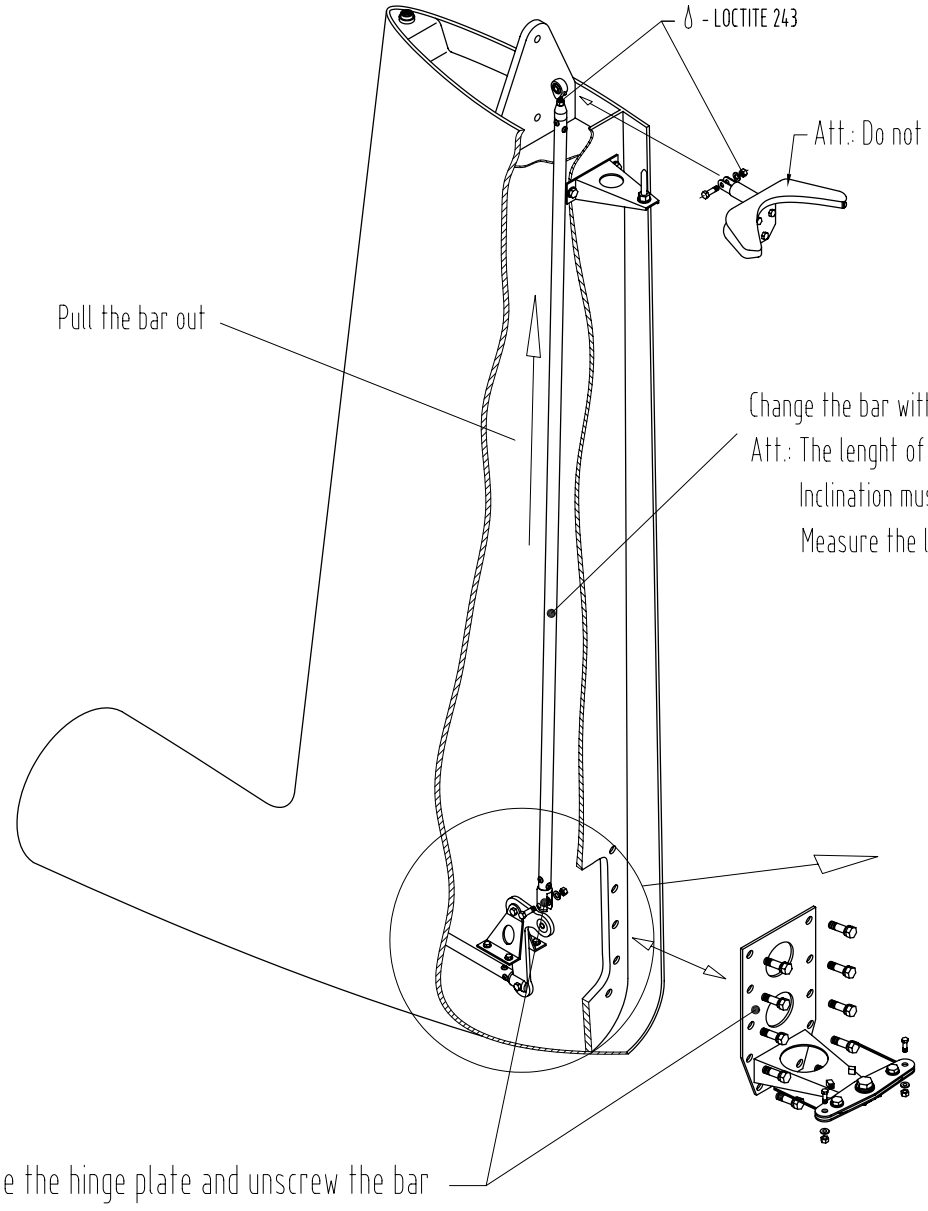
Airbrake Guidance Installation

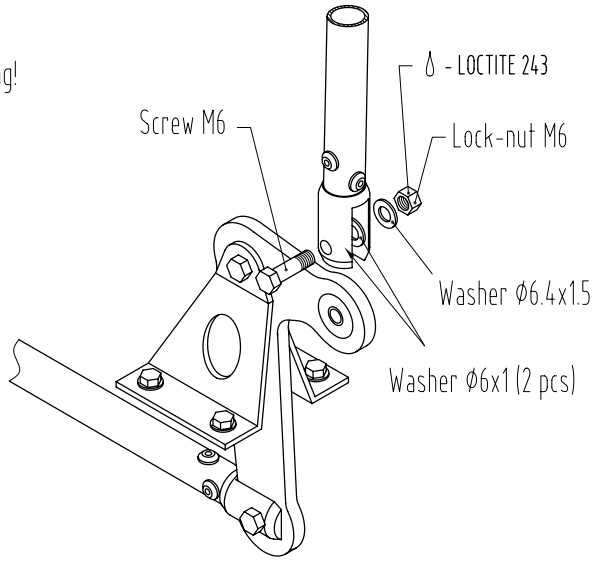
Venting the Hydraulic Brake Lines

Wheel Brake Repair

Nose Wheel Strut Assembly

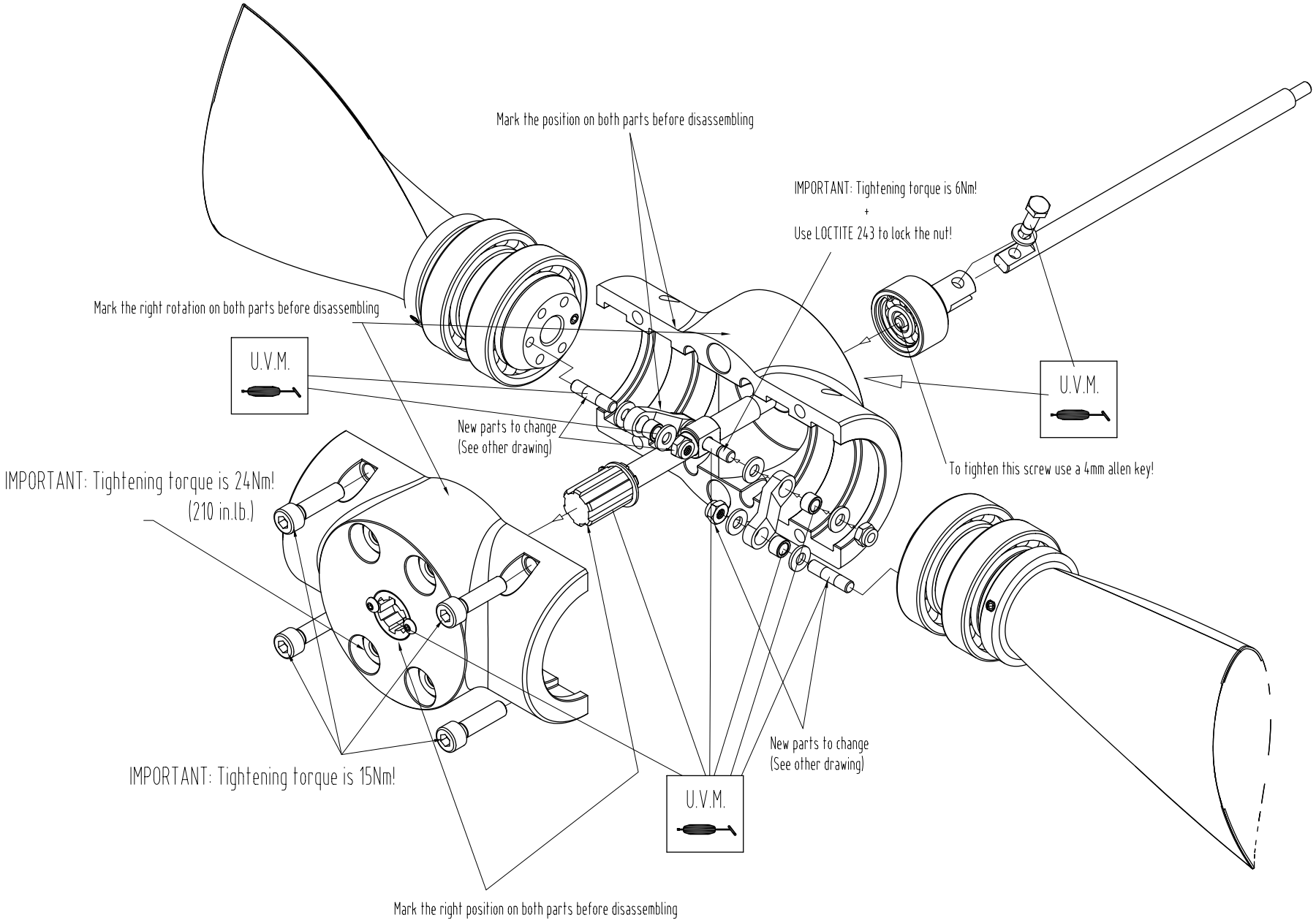
Elevator Vertical Pushrod Replacement


- LOCTITE 243
Att.: Do not remove this part!
Pull the bar out
Change the bar with the new one
Att.: The lenght of the new bar must be the same as the old one!
Inclination must remain the same!
Measure the length from bottom screw to the upper bearing!
Remove the hinge plate and unscrew the bar

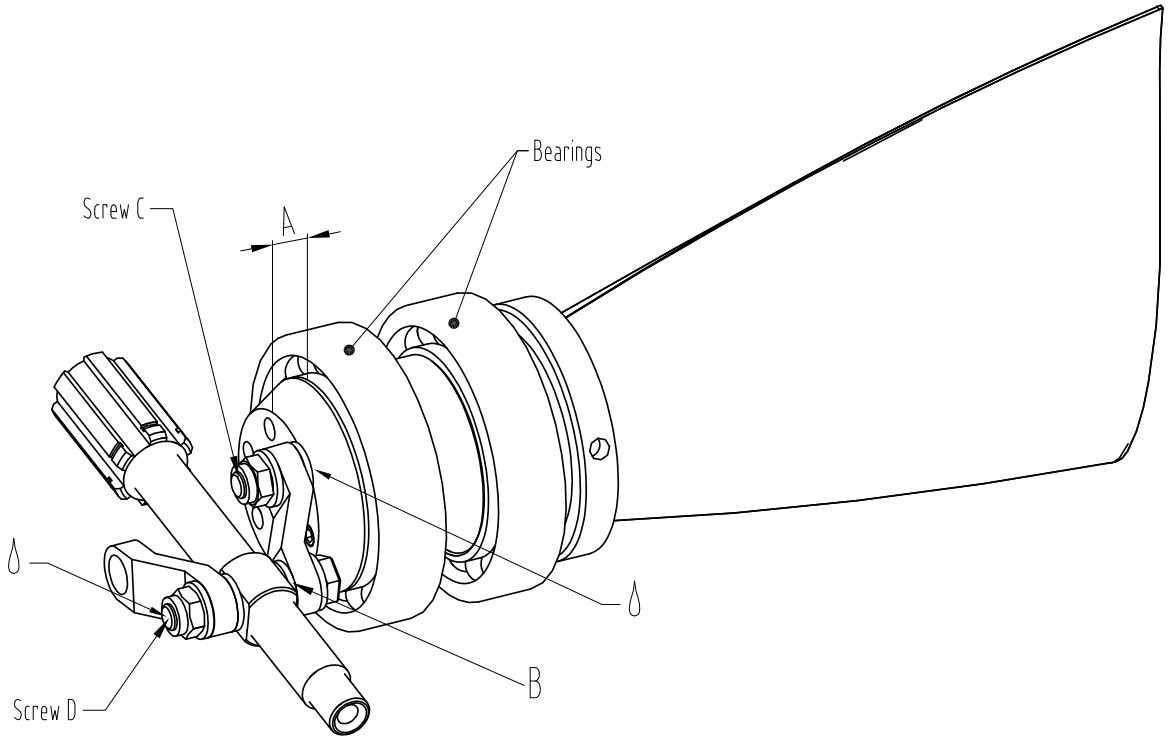


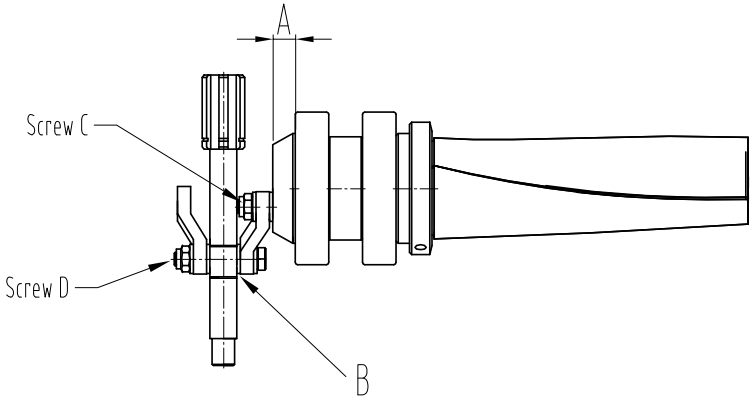
-- Use LOCTITE 243 to lock the nut!

VARIO Propeller Assembly


Mark the position on both parts before disassembling
IMPORTANT: Tightening torque is 6Nm!
+
Use LOCTITE 243 to lock the nut!
Mark the right rotation on both parts before disassembling
U.V.M.
U.V.M.
New parts to change
(See other drawing)
To tighten this screw use a 4mm allen key!
IMPORTANT: Tightening torque is 24Nm!
(210 in.lb.)
New parts to change
(See other drawing)
IMPORTANT: Tightening torque is 15Nm!
U.V.M.
Mark the right position on both parts before disassembling

VARIO Propeller Drive Replacement





REPLACING PROCEDURE:

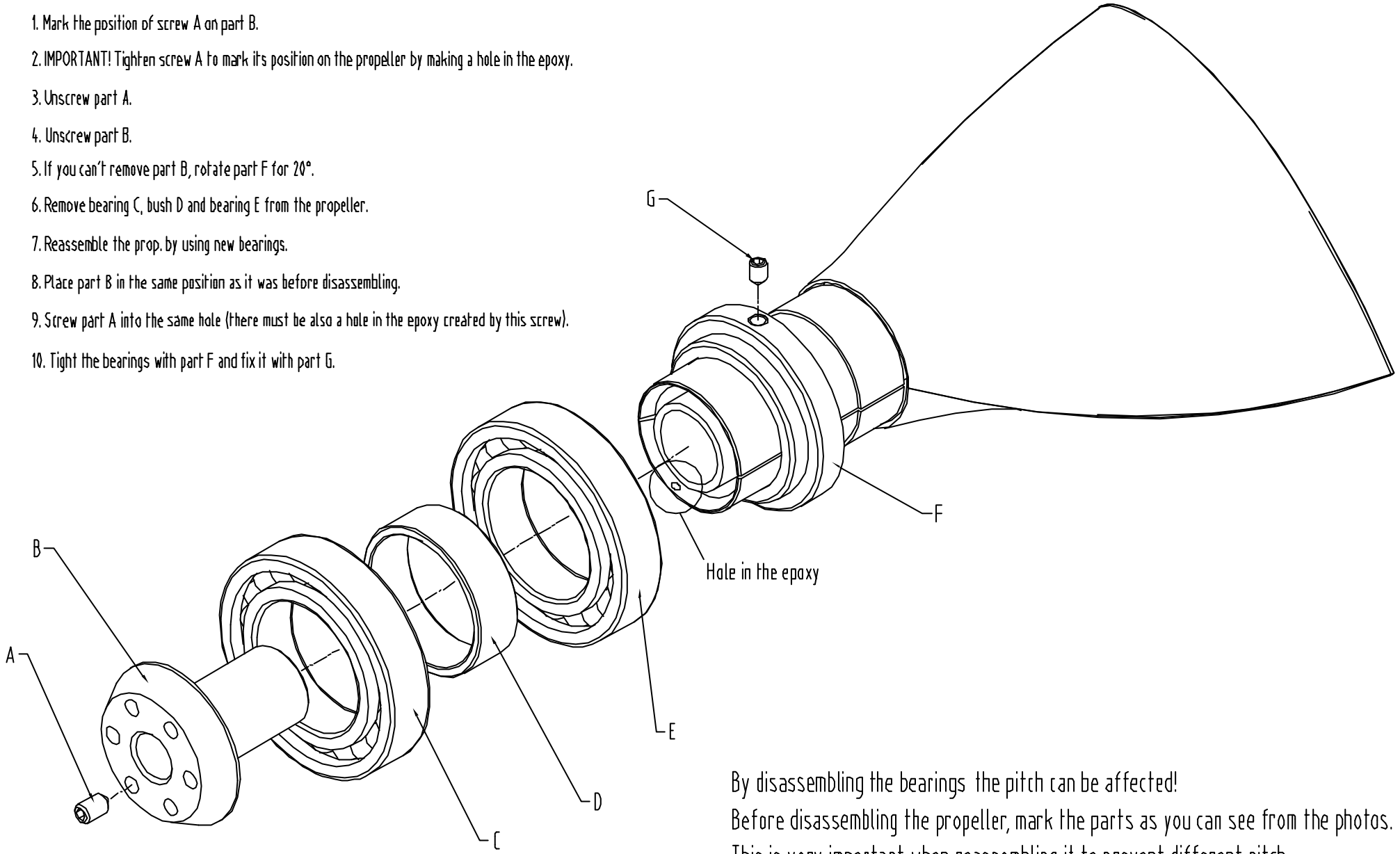
1. Measure the distance A
   1.1. If the distance A is 10 mm (0.394"), insert a 1.5 mm (0.059") wide washer B
   1.2. If the distance A is 9.1 mm (0.358"), replace the existing washer with a 2.4 mm (0.094") wide washer B

2. If you replace washers B on both propeller blades, replace also the screw D with the longer one
   IMPORTANT: Tightening torque: 6 Nm (55 in.lb.)!

3. Check the crevice on screw C
   If the crevice is too big, replace also the screw C and use LOCTITE 270 to lock it
   IMPORTANT: Tightening torque: 6 Nm (55 in.lb.)!

VARIO Propeller Bearing Replacement

1. Mark the position of screw A on part B.
2. IMPORTANT! Tighten screw A to mark its position on the propeller by making a hole in the epoxy.
3. Unscrew part A.
4. Unscrew part B.
5. If you can't remove part B, rotate part F for 20°.
6. Remove bearing C, bush D and bearing E from the propeller.
7. Reassemble the prop. by using new bearings.
8. Place part B in the same position as it was before disassembling.
9. Screw part A into the same hole (there must be also a hole in the epoxy created by this screw).
10. Tight the bearings with part F and fix it with part G.

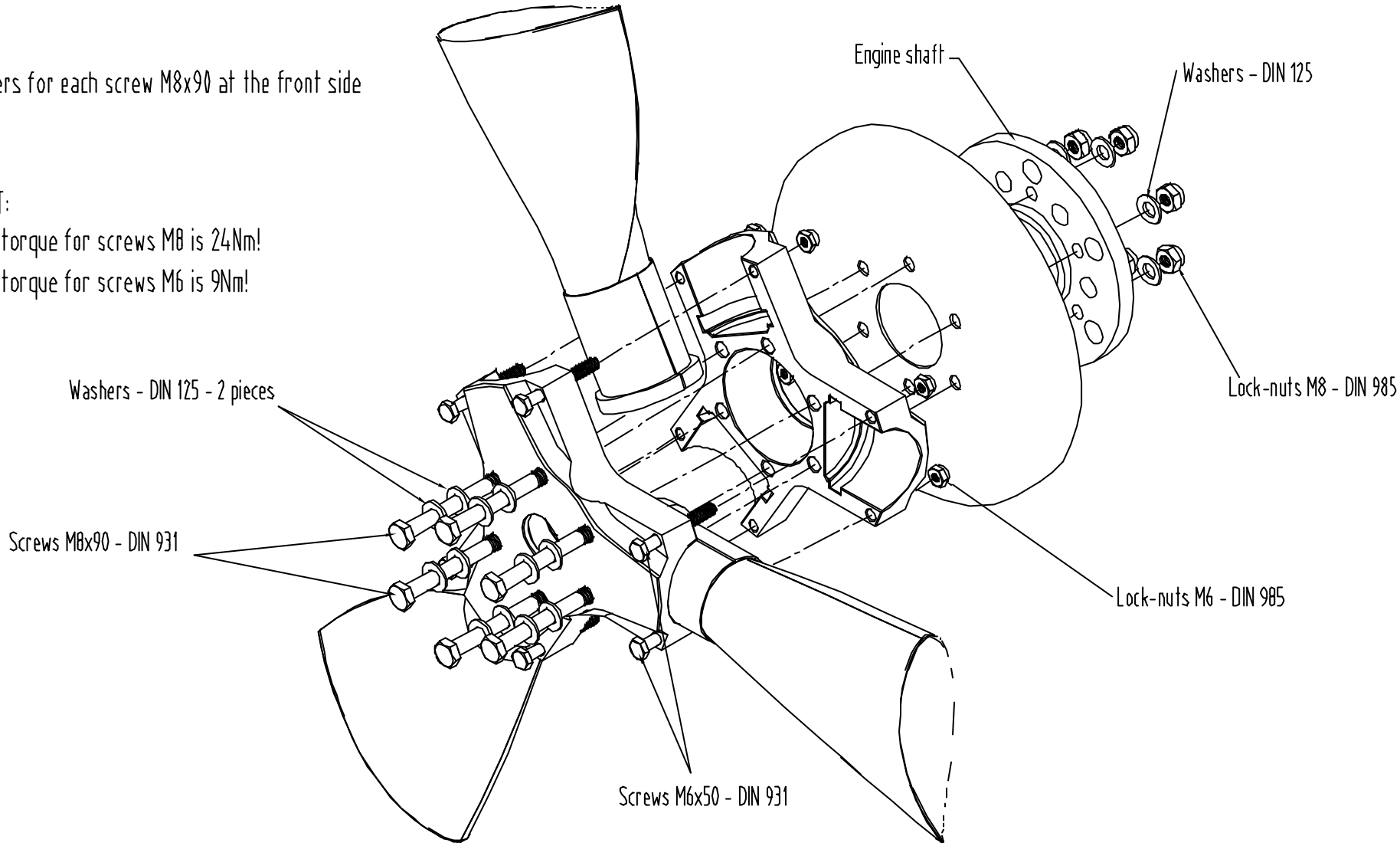


By disassembling the bearings the pitch can be affected!
Before disassembling the propeller, mark the parts as you can see from the photos.
This is very important when reassembling it to prevent different pitch.

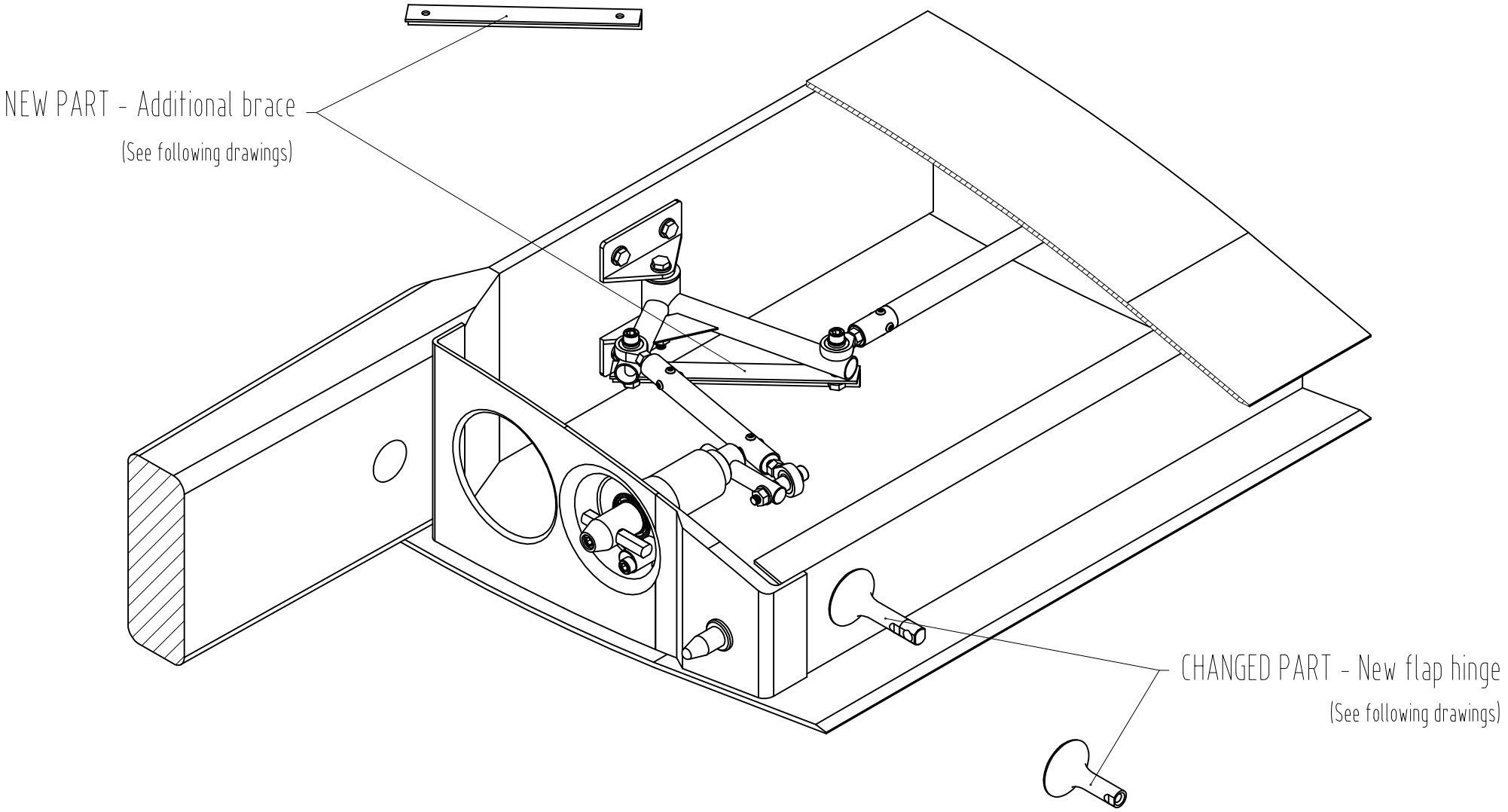
3-Bladed Fixed Pitch Propeller Assembly

Use 2 washers for each screw M8x90 at the front side

IMPORTANT:
Tightening torque for screws M8 is 24Nm!
Tightening torque for screws M6 is 9Nm!

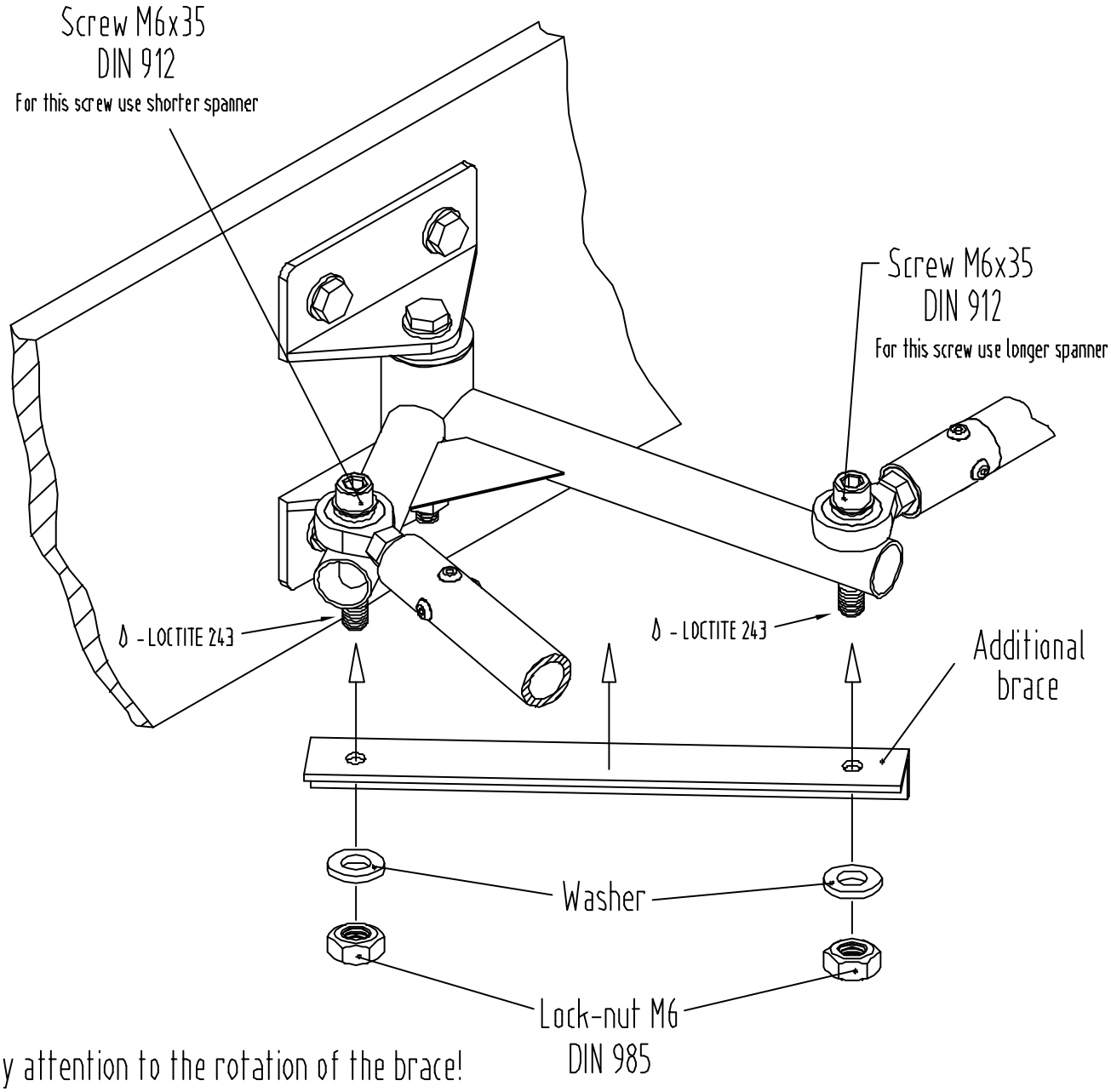

Engine shaft
Washers - DIN 125
Lock-nuts M8 - DIN 985
Washers - DIN 125 - 2 pieces
Screws M8x90 - DIN 931
Lock-nuts M6 - DIN 985
Screws M6x50 - DIN 931

Airbrake Control's Drive Reinforcement (part 1)



Wing Control's Drive Reinforcement (part 2)

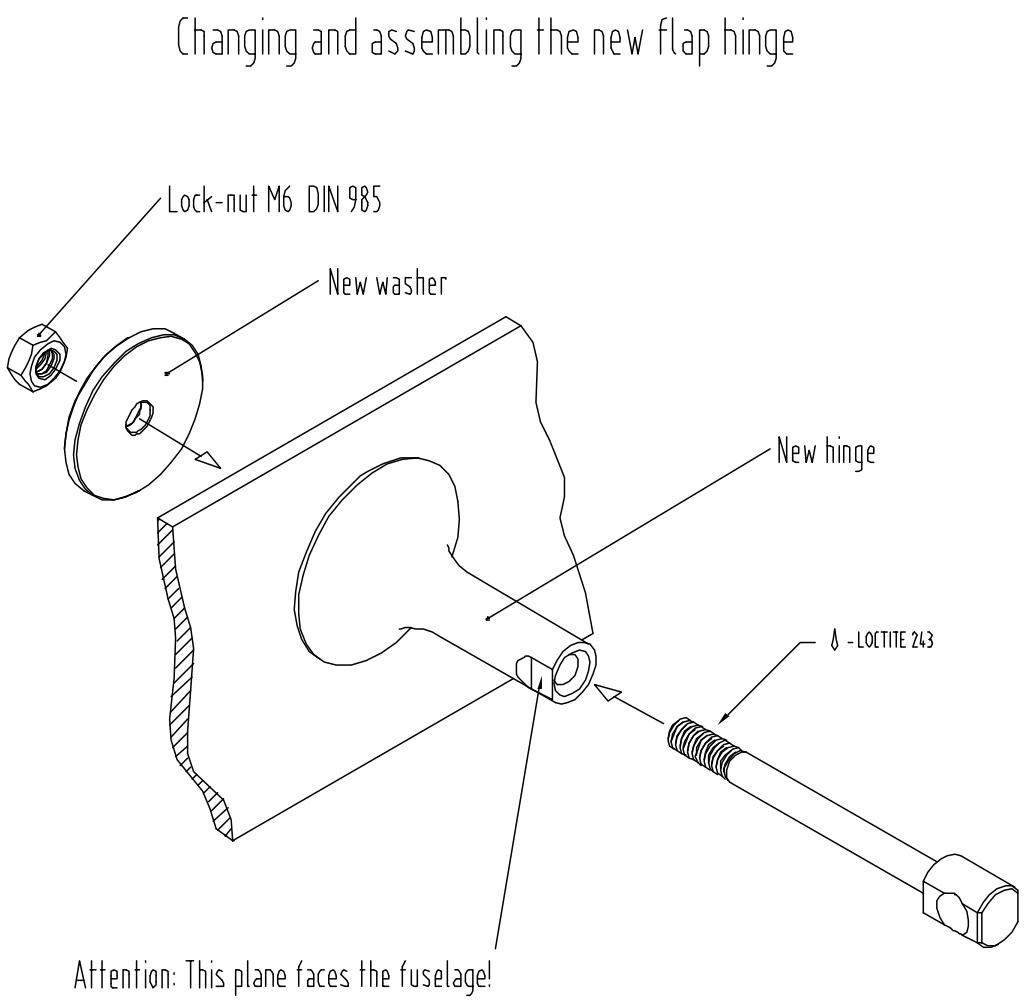
Assembling the additional brace



Pay attention to the rotation of the brace!

-- Use LOCTITE 243 to lock the nut!

Flaperon Hinge Reinforcement

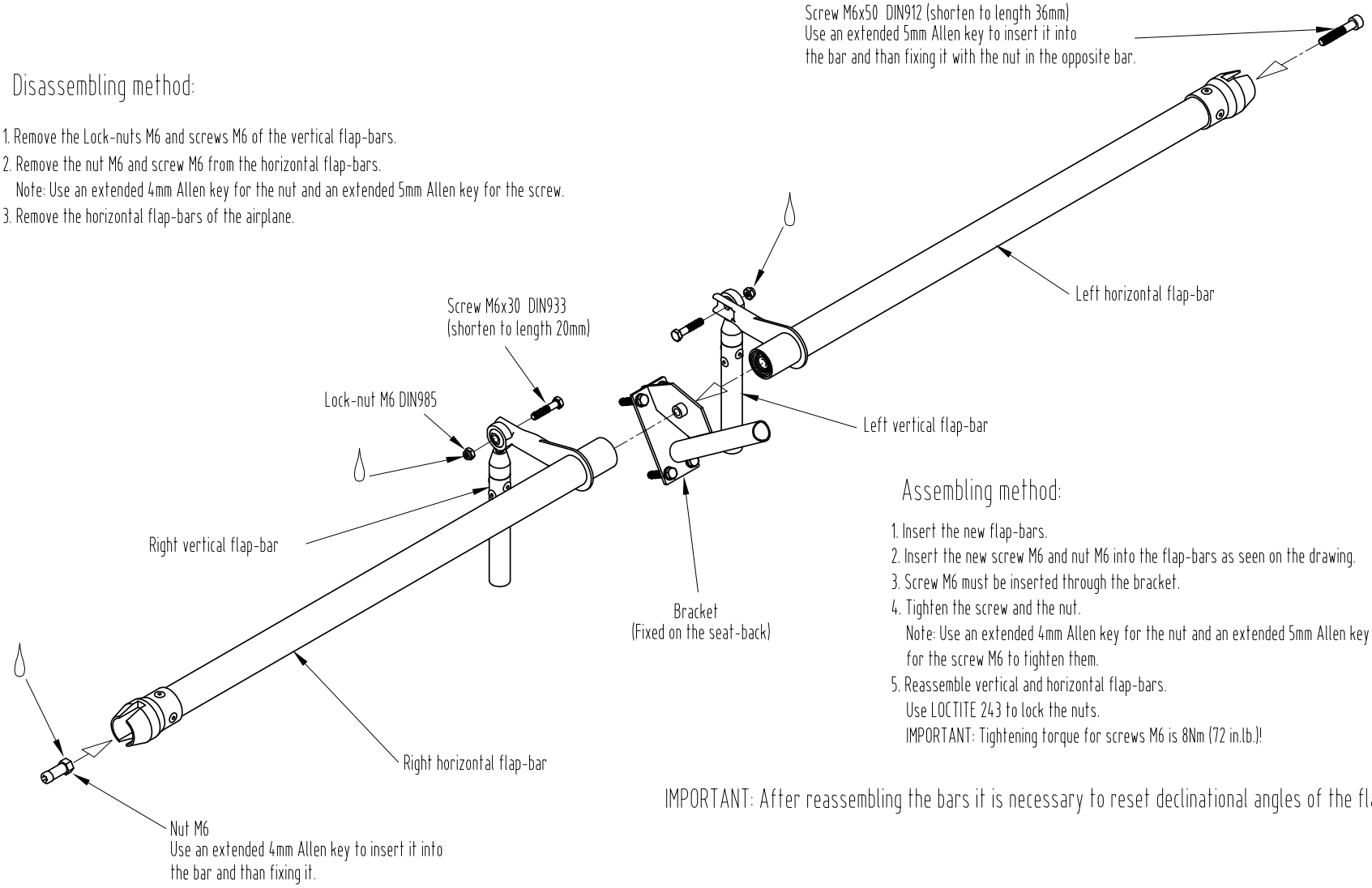

Changing and assembling the new flap hinge
Lock-nut M6 DIN 985
New washer
New hinge
◊ - LOCTITE 243
Attention: This plane faces the fuselage!

◊ -- Use LOCTITE 243 to lock the nut!

Flaperon Lateral Drive Assembly

Disassembling method:

1. Remove the Lock-nuts M6 and screws M6 of the vertical flap-bars.
2. Remove the nut M6 and screw M6 from the horizontal flap-bars.
   Note: Use an extended 4mm Allen key for the nut and an extended 5mm Allen key for the screw.
3. Remove the horizontal flap-bars of the airplane.


Screw M6x50 DIN912 (shorten to length 36mm)
Use an extended 5mm Allen key to insert it into
the bar and than fixing it with the nut in the opposite bar.
Left horizontal flap-bar
Screw M6x30 DIN933
(shorten to length 20mm)
Lock-nut M6 DIN985
Left vertical flap-bar
Right vertical flap-bar
Bracket
(Fixed on the seat-back)
Right horizontal flap-bar
Nut M6
Use an extended 4mm Allen key to insert it into
the bar and than fixing it.

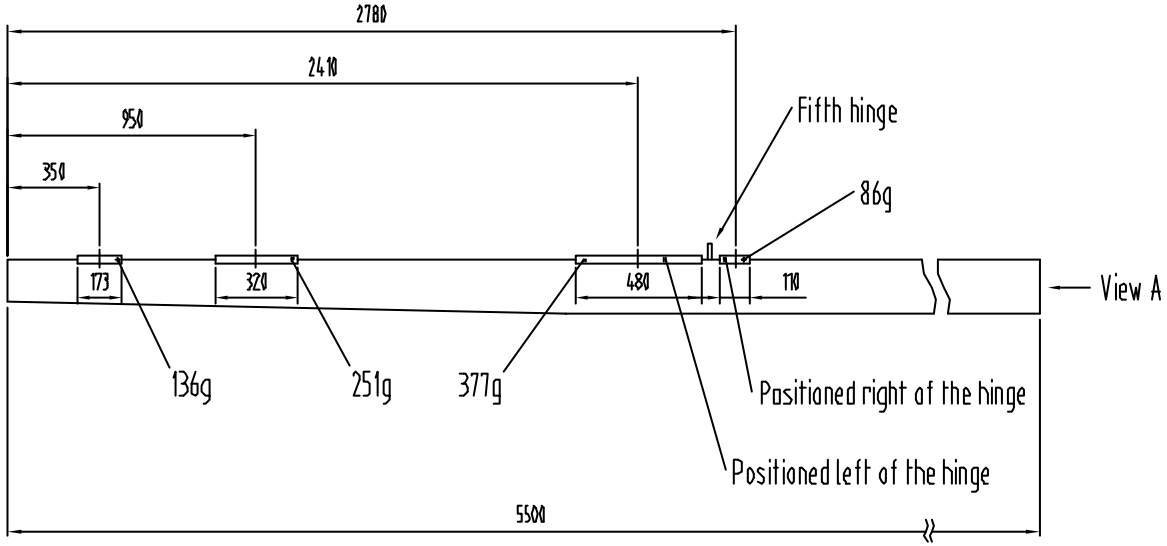
Assembling method:

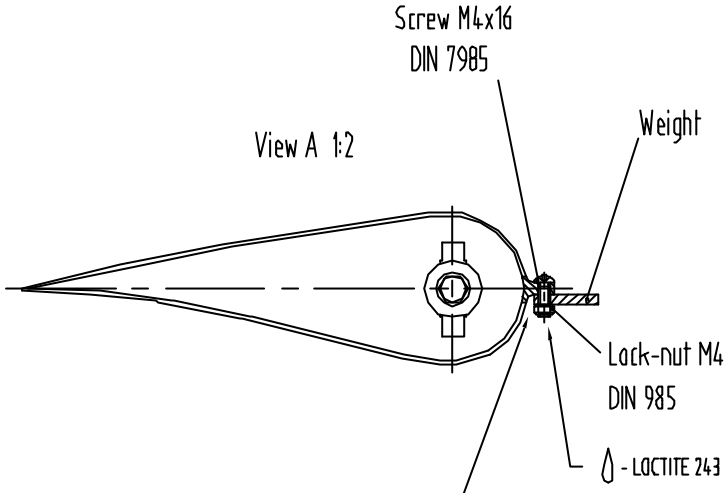
1. Insert the new flap-bars.
2. Insert the new screw M6 and nut M6 into the flap-bars as seen on the drawing.
3. Screw M6 must be inserted through the bracket.
4. Tighten the screw and the nut.
   Note: Use an extended 4mm Allen key for the nut and an extended 5mm Allen key for the screw M6 to tighten them.
5. Reassemble vertical and horizontal flap-bars.
   Use LOCTITE 243 to lock the nuts.
   IMPORTANT: Tightening torque for screws M6 is 8Nm (72 in.lb.)!

IMPORTANT: After reassembling the bars it is necessary to reset declinational angles of the flaps!

💧 -- Use LOCTITE 243 to lock the nut!

Flaperon Mass Balance Weights Installation

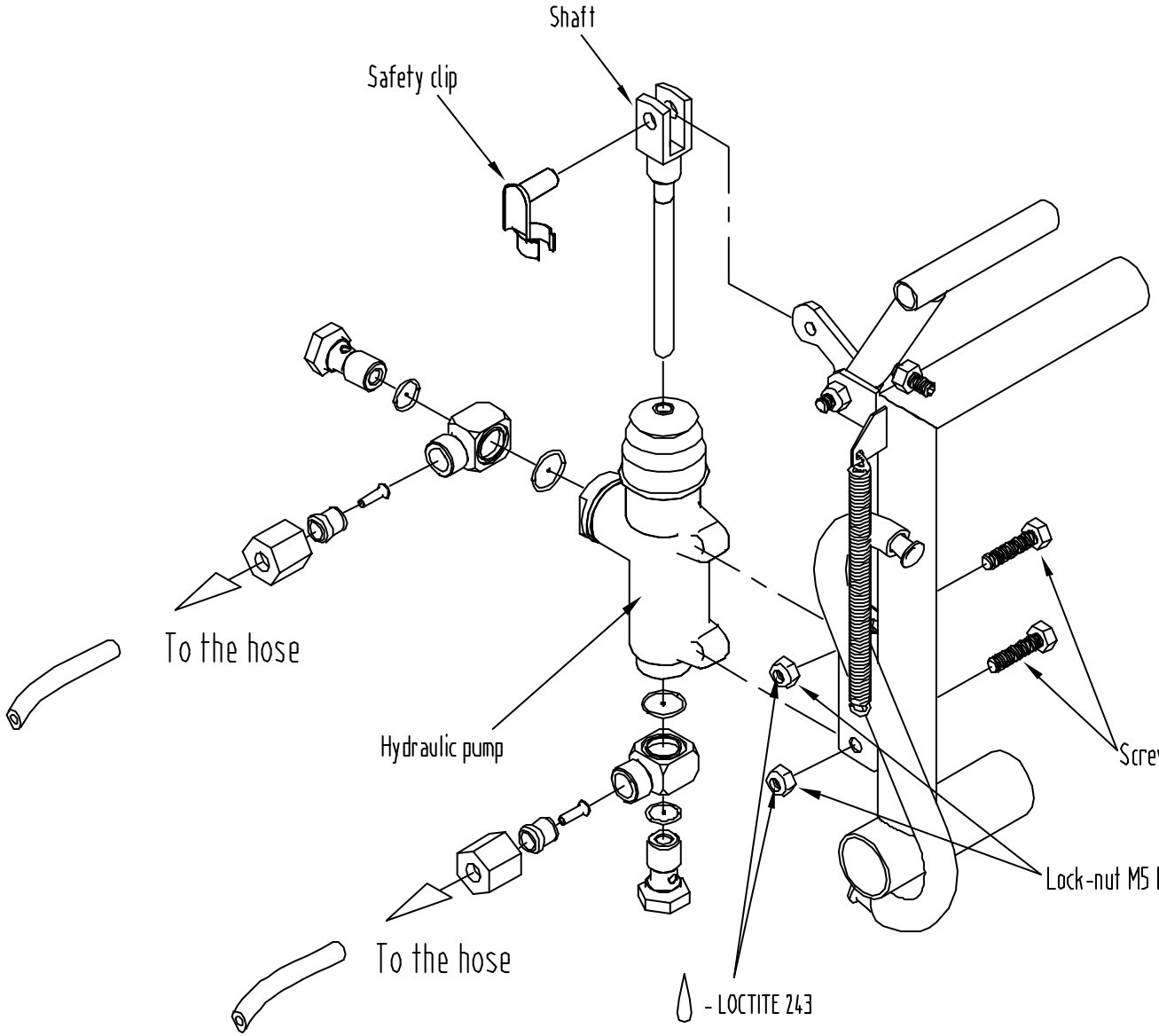




-- Use LOCTITE 243 to lock the nut!

Attention: Right wing is just the opposite of the left wing!

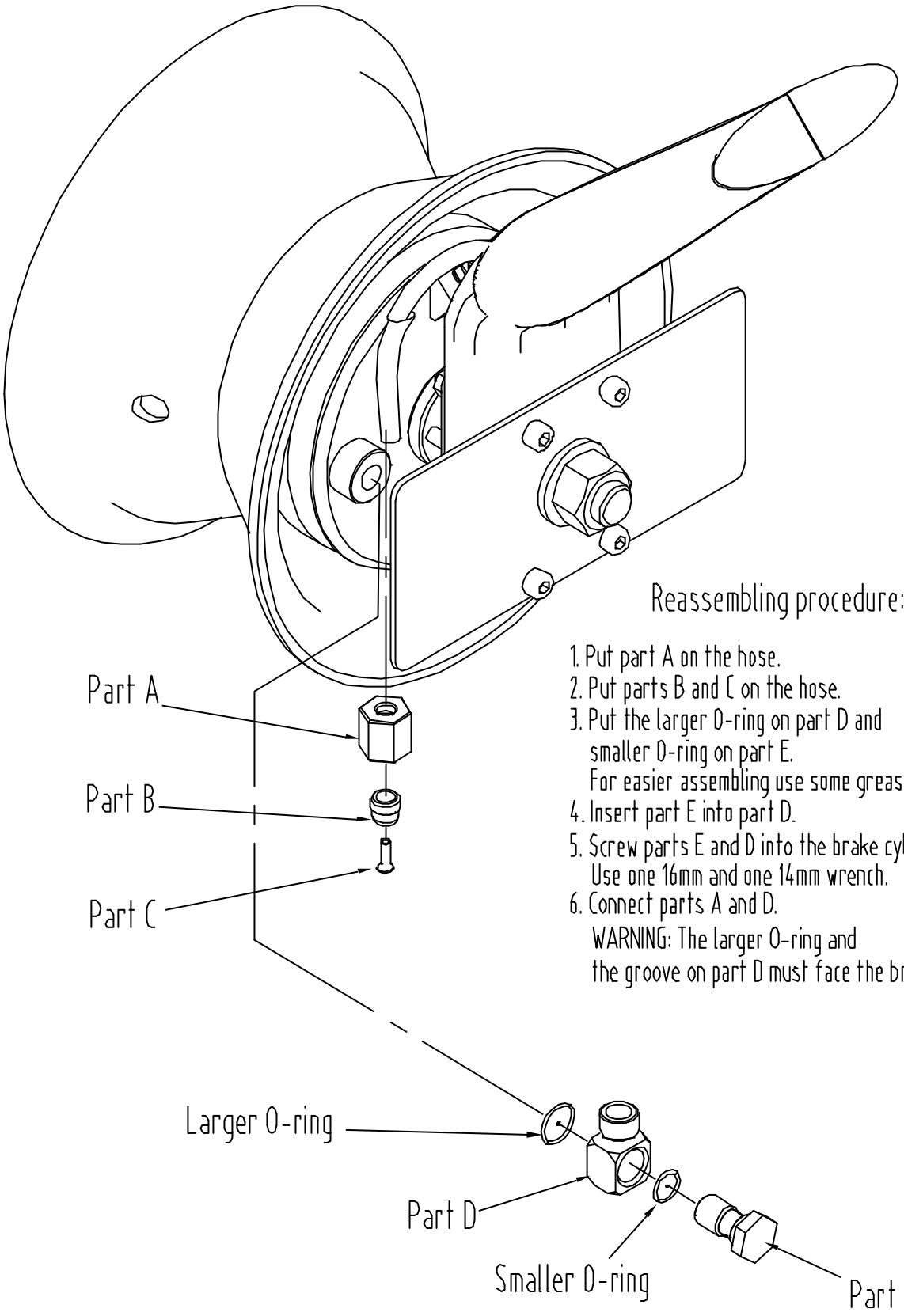
Wheel Brake (cockpit side) Assembly



Disassembling procedure:

1. Remove the hoses off the connectors after marking their positions.
2. Remove the safety clip off the shaft and then the shaft of the hydraulic pump. The shaft is inserted and not screwed.
3. Remove the hydraulic cylinder (pump) off the pedal by removing the two screws M5.
4. Remove the oil hose connections off the pump. Use one 16mm and one 14mm wrench to unscrew them.
5. Reassemble the connections as described in drawing Mex.002.
6. Reassemble the cylinder and the pedal using a reverse form of procedure as described above.
   IMPORTANT: Tightening torque for screws M5 is 7Nm (60 in.lb.)
   + use LOCTITE 243 to prevent lock-nut to unscrew!

Hydraulic Fluid Lines Assembly (wheel side)

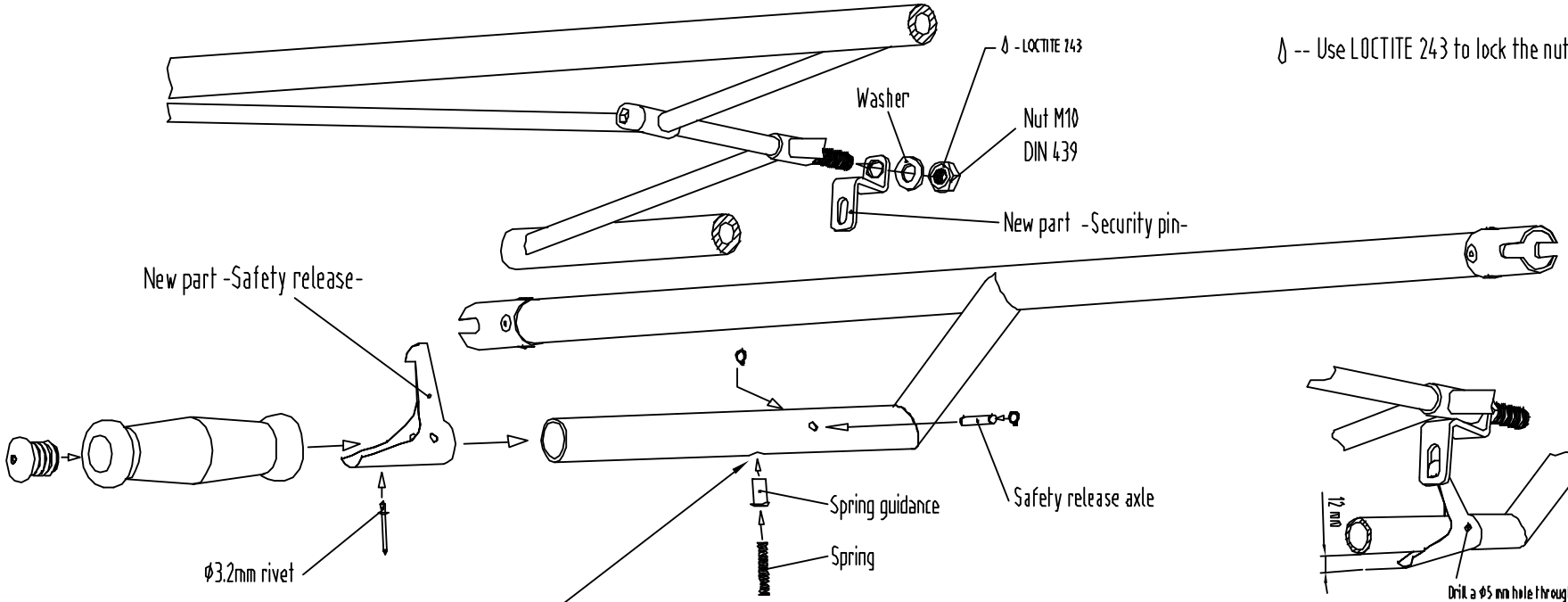


Reassembling procedure:

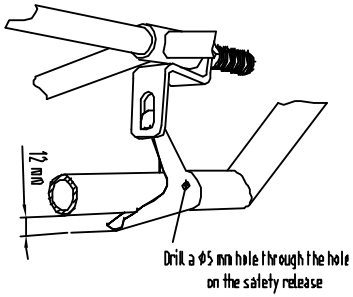
1. Put part A on the hose.
2. Put parts B and C on the hose.
3. Put the larger O-ring on part D and smaller O-ring on part E.
   For easier assembling use some grease.
4. Insert part E into part D.
5. Screw parts E and D into the brake cylinder.
   Use one 16mm and one 14mm wrench.
6. Connect parts A and D.
   WARNING: The larger O-ring and the groove on part D must face the brake cylinder!

Note: Pneumatic tire and wheel spat are not drawn for visibility purposes

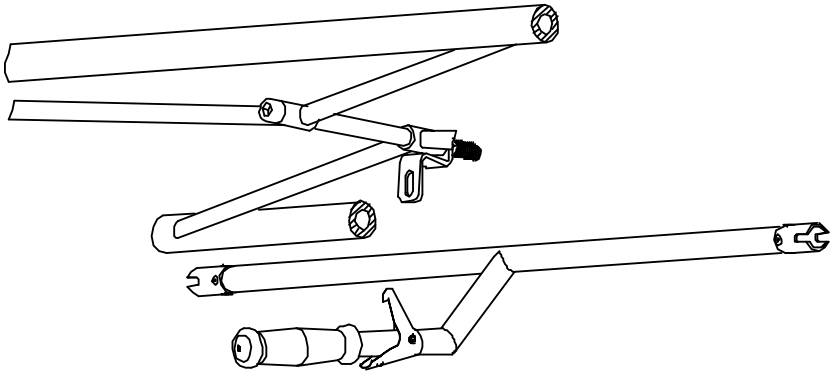
Airbrake Handle Assembly



Δ -- Use LOCTITE 243 to lock the nut!

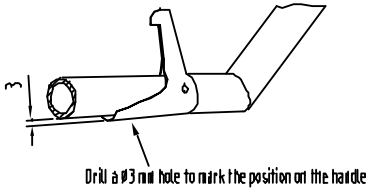


Assembled:

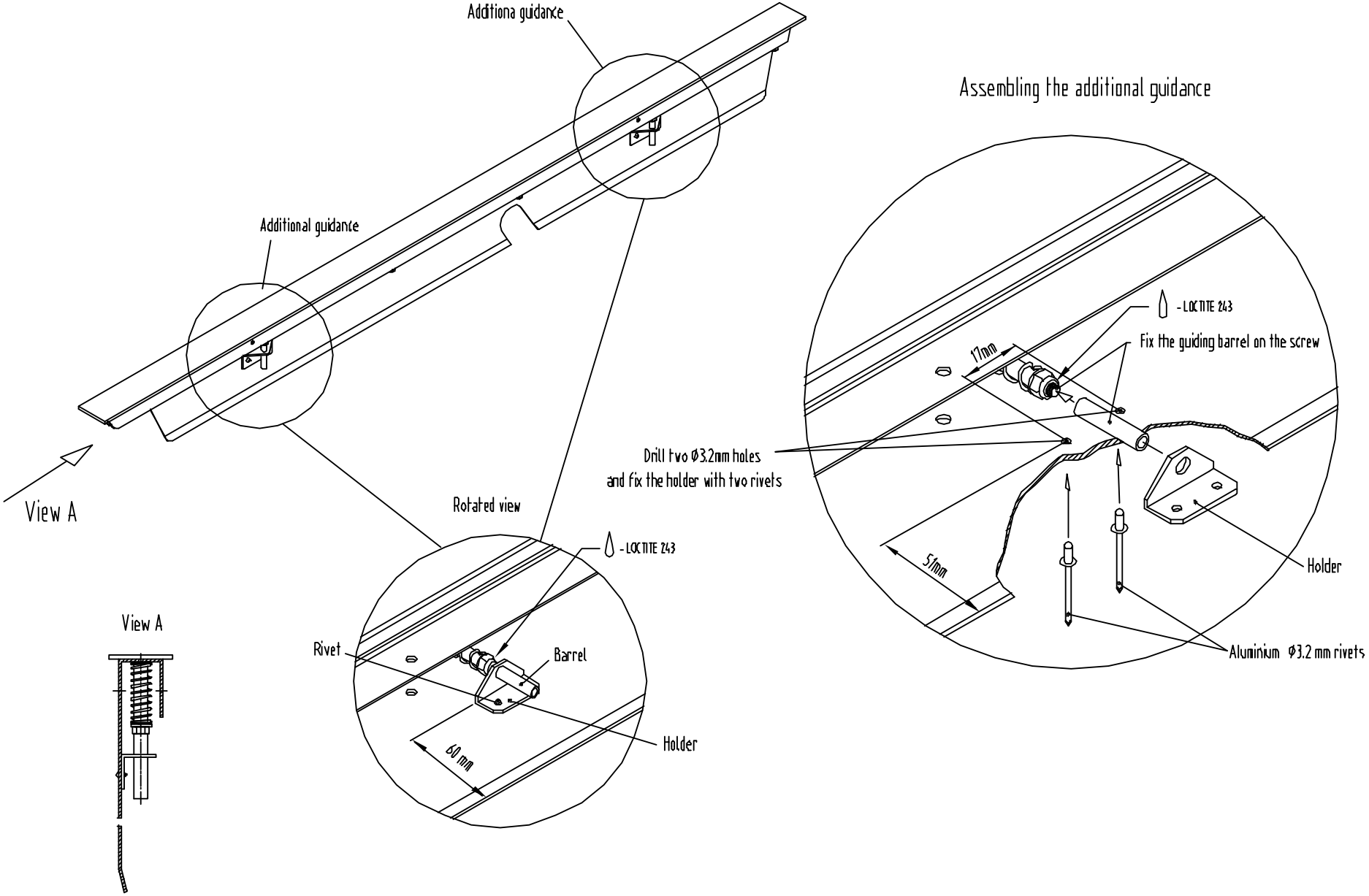


Assembling method:

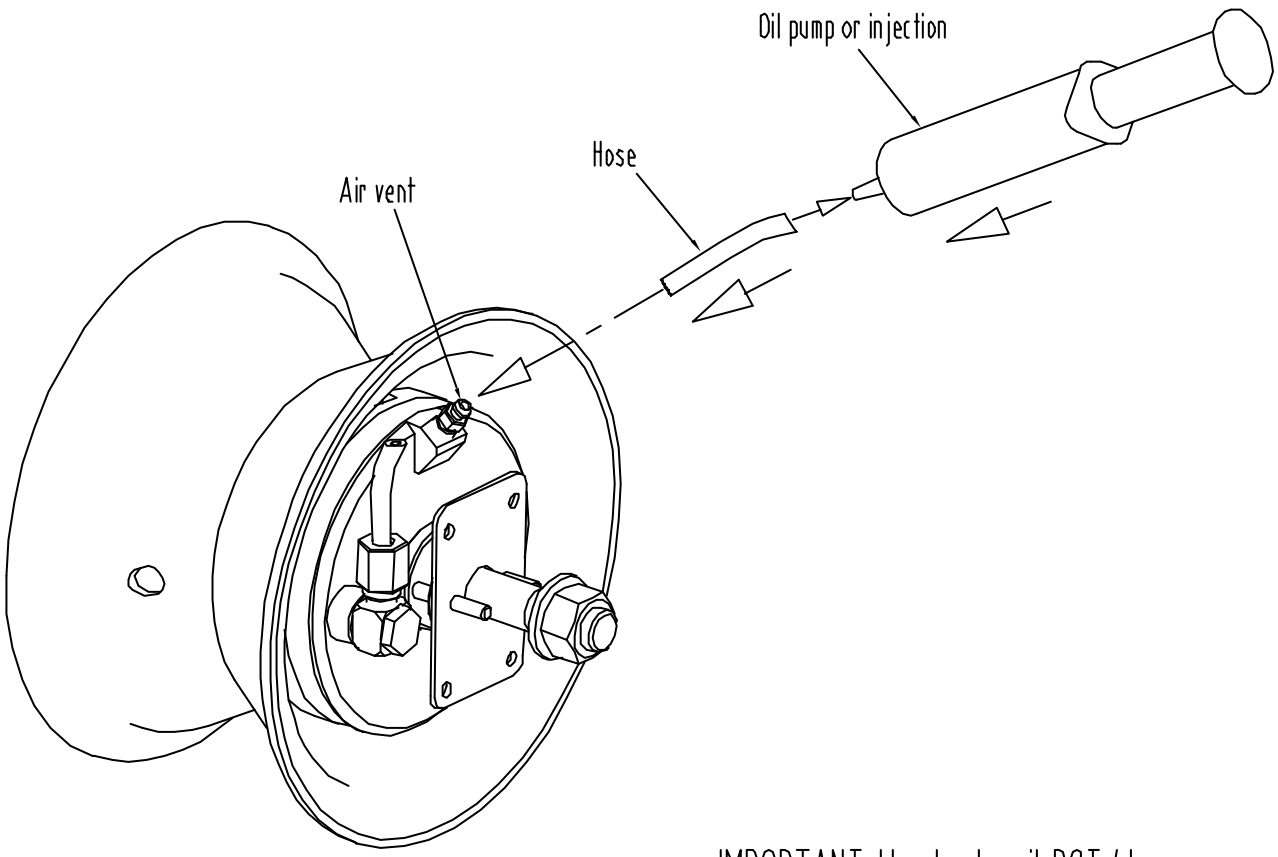
1. Assemble the upper security pin.
2. Put on the safety release.
3. Incline the safety release for 12 mm so that safety release and security pin are connected (see the drawing above).
4. Drill a Ø5 hole and insert the safety release axle.
5. Mark the place of the spring guidance with a Ø3mm borer and remove the safety release (see the drawing below).
6. Place the rivet on the safety release.
7. Drill a Ø8 mm hole for the spring guidance.
8. Insert the spring guidance and the spring into the hole.
9. Place the safety release on the handle.



Airbrake Guidance Installation



Venting the Hydraulic Brake Lines



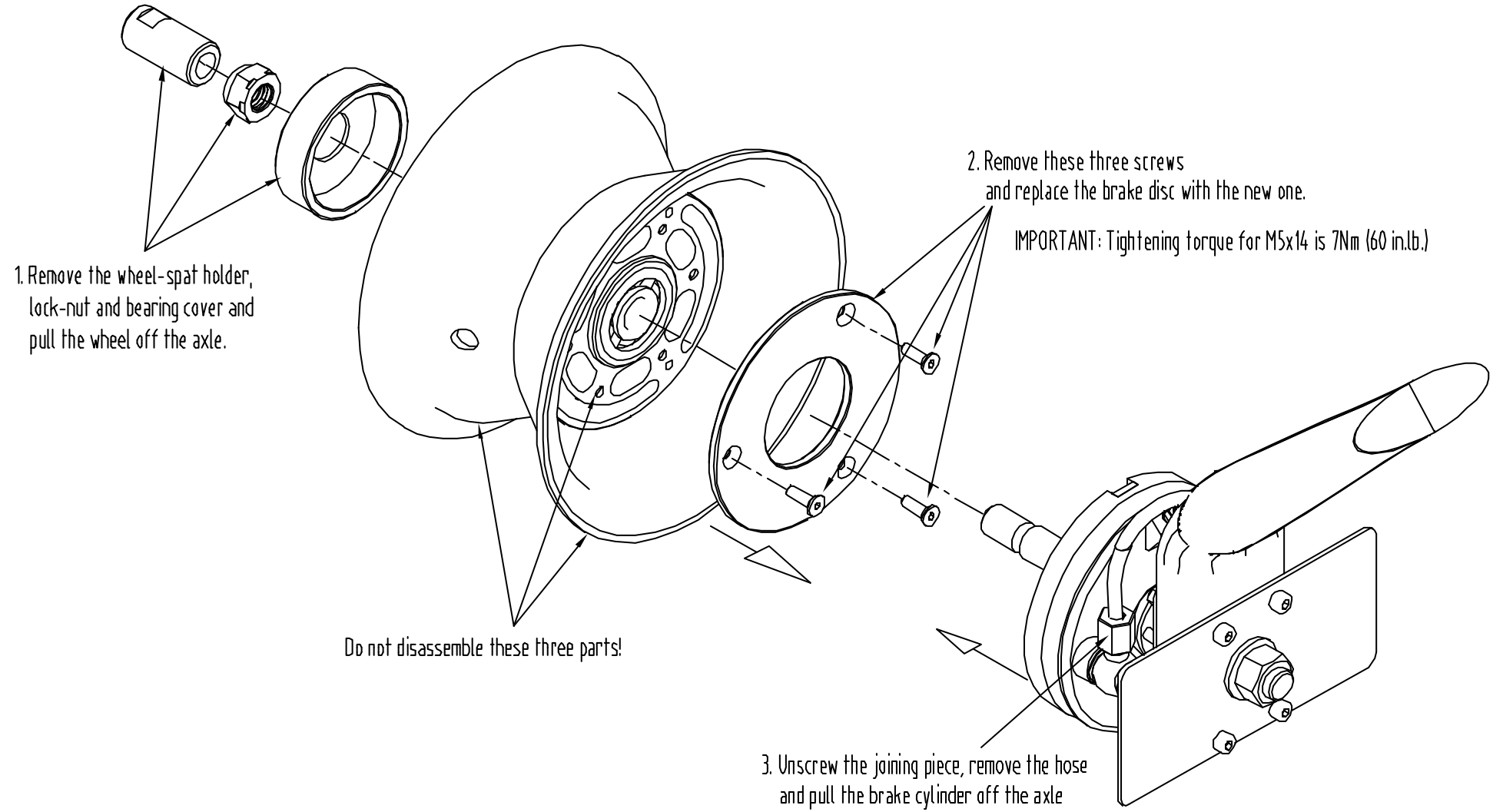
IMPORTANT: Use brake oil DOT 4!

How to get the air out of the system:

1. Get an oil pump or a syringe (capacity at least 100ml).
2. Unscrew the air vent (not more than 360 degrees).
3. Get a 100mm long hose (as soft as you can get) and fix it on the air vent.
4. Fill the syringe with oil and put it on the hose.
5. Before injecting oil remove the springs from the pedals (the ones without tanks) and lay them forward on the floor. It is also recommended that you pump the pedals when injecting the oil.
6. When done open the tanks on the opposite pedals and start filling the oil from the syringe.

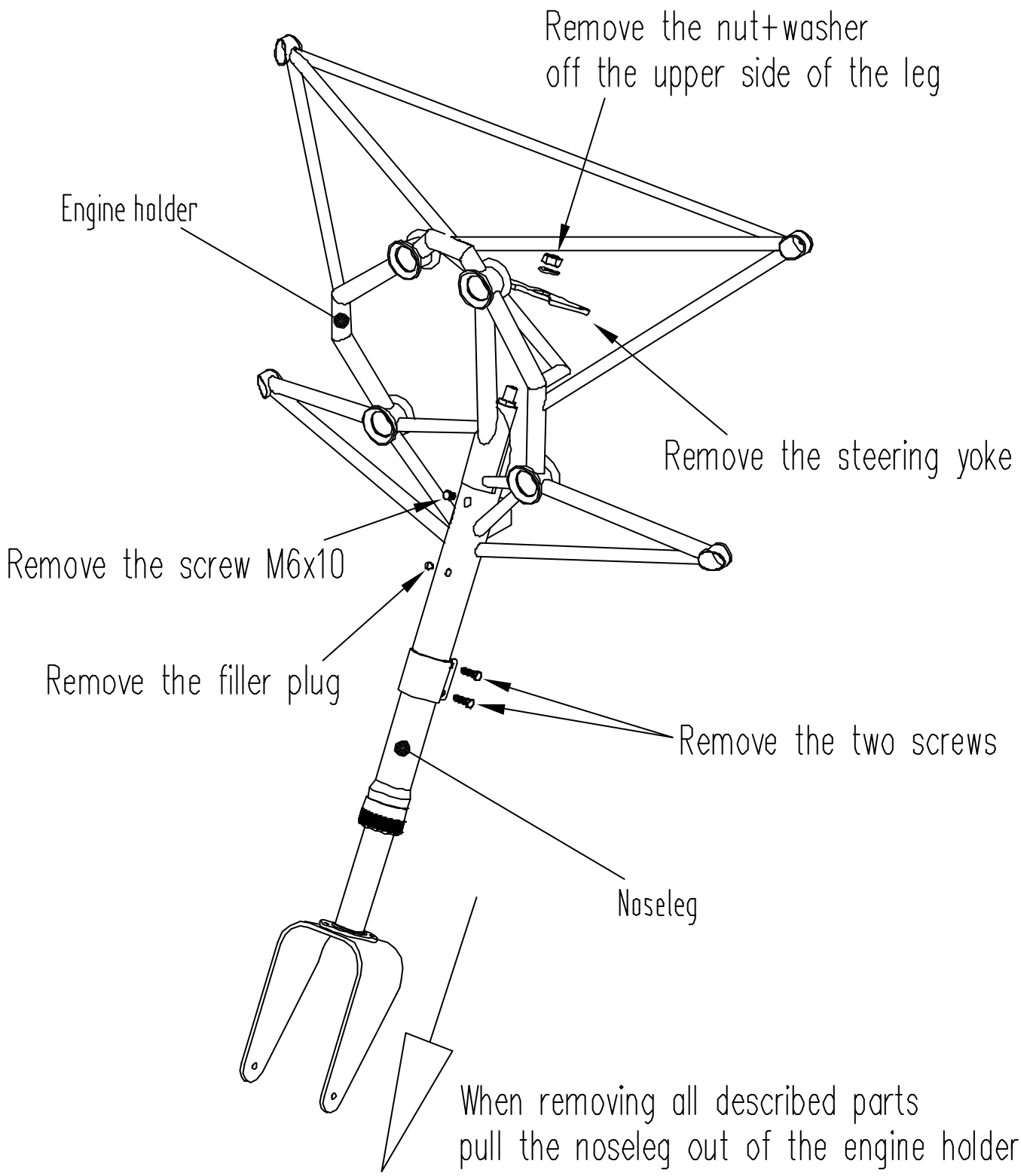
   To get all the air out of the system turn the tanks around and let the oil flow into a vessel that you have put under it.
6. When you notice that there is no oil in the system left, turn the tanks back to its original position and fill them up with oil.

Wheel Brake Repair


1. Remove the wheel-spat holder, lock-nut and bearing cover and pull the wheel off the axle.
2. Remove these three screws and replace the brake disc with the new one.
IMPORTANT: Tightening torque for M5x14 is 7Nm (60 in.lb.)
Do not disassemble these three parts!
3. Unscrew the joining piece, remove the hose and pull the brake cylinder off the axle

Note: Pneumatic tire and wheel spat are not drawn for visibility purposes

Nose Wheel Strut Assembly


Remove the nut+washer
off the upper side of the leg
Engine holder
Remove the steering yoke
Remove the screw M6x10
Remove the filler plug
Remove the two screws
Noseleg
When removing all described parts
pull the noseleg out of the engine holder

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